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ABSTRACT

Thirteen studies were conducted that focused on whether preschool and elementary school students with mild and moderate disabilities learned target and non-target behaviors when two types of instructional manipulations were made to direct instructional trial sequences. In one type, the related, non-target behaviors were presented during attentional cues in the antecedent portion of trial sequences. In the second type, the related, non-target behaviors were presented during the consequent events for students' responses (instructive feedback). The accomplishments of the project and a summary of the 13 studies are included. Findings include: (1) during direct instruction, use of an attentional cue and response that provided additional information and focuses attention on the distinctive features of the target stimulus may result in acquiring the target behaviors; (2) active attentional responses as compared to inactive responses may result in more acquisition of the additional stimuli; and (3) the addition of extra, related, non-target stimuli in the antecedent portion of trials may interfere with acquisition of the target response when children do not have a history of direct instruction. Several appendices include antecedent and consequent event manipulation manuals, an instructional module for faculty and inservice training instructors, and relevant articles and reports. (Author/CR)

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FINAL REPORT

LEARNING EFFICIENTLY: ACQUISITION OF RELATED, NON-TARGET BEHAVIORS

PROJECT LEARN

Grant No. HO23C00125

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ABSTRACT

Learning Efficiently:

Acquisition of Related Non-Target Behaviors (Project LEARN)

Several effective strategies and practices exist for teaching students with disabilities, but less is known about facilitating the efficiency of direct instruction (Wolery, Ault, & Doyle, 1992). Efficiency can be measured in at least two ways: (a) one procedure is compared to another and is considered more efficient when students learn an equal number of behaviors in fewer sessions, trials, errors, or minutes of instructional time (i.e., results in more rapid learning); and (b) two strategies may result in equally rapid learning, but one may allow the students to learn more behaviors - those taught directly and those not taught directly - thus, the more efficient strategy is the one that results in multiple behaviors being learned (i.e., those that are targeted for instruction and related non-target behaviors). The Learning Efficiently: Acquisition of Related, Non-target Behaviors project (Project LEARN) focused on this second means of measuring efficiency. Specifically, Project LEARN focused on whether student with mild and moderate disabilities learned target and non-target behaviors when two types of instructional manipulations were made to direct instructional trial sequences. In one type, the related, non-target behaviors were presented during attentional cues in the antecedent portion of trial sequences; and in the second type, the related, non-target behaviors were presented during the consequent events for students' responses (this manipulation is now called "instructive feedback").

Project LEARN originally proposed to conduct 12 investigations, but actually conducted 13 studies over a three year period. Four studies were proposed as demonstrations of the effects of the antecedent manipulations, and two were conducted; four studies were proposed as demonstrations of the consequent-events manipulations (instructive feedback), and five were conducted; four studies were proposed to compare methods for presenting the two manipulations and/or to compare the two manipulations, and six were conducted. The research was conducted in preschool and elementary school classrooms with students who had mild to moderate disabilities. The research occurred within the context of the usual instruction activities such as small group instruction. The students teachers

implemented the experimental sessions in most studies. Direct observation of children's acquisition of target behaviors occurred on a daily basis, and direct observation prior to instruction and when children achieved criterion on their target behaviors was used to evaluate the effects of the antecedent manipulations and the instructive feedback. The research used single subject experimental designs (i.e., the multiple probe design, the adapted alternating treatments design, and the parallel treatments design).

Over the three years of the project, 13 separate investigations occurred. Ten of these were sufficiently successful to be described and submitted for publication. Two have been published, three are in press, and five are currently under review. In addition, a review of the constant time delay procedure (the strategy used in much of the research) has been published, and a manuscript describing how to use the consequent events manipulation (i.e., instructive feedback) has been submitted for publication. Presentations of Project LEARN studies and findings have been made at nine professional conferences and one is scheduled for November of 1992. Also, workshops have been conducted that included Project LEARN findings in ten states across the nation. Finally, two manuals for practitioners, students in training, and faculty have been developed and disseminated; and one instructional module for faculty and inservice training instructors has been developed.

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FINAL REPORT: NARRATIVE

Learning Efficiently: Acquisition of Related, Non-Target Behaviors (Project LEARN)

Principal Investigator: Mark Wolery, PhD

Background

In this section of the report, we describe the background of the project. First, the history of the project is described briefly, and then the conceptual base and origins of the research conducted on the project are described. Finally, the objectives as proposed in the original application are listed.

History of Project LEARN

The Learning Efficiently: Acquisition of Related, Non-target Behaviors (Project LEARN) was a 3-year grant from the Field-Initiated Research Competition of the Innovation and Development Branch of the Office of Special Education and Rehabilitative Services of the U.S. Department of Education. The grant (Grant No. H023C90120) was originally awarded to the Department of Special Education, University of Kentucky, Lexington, Kentucky in 1989 (start date: 08/01/89; the awarded notice was received in October of 1989). The project originally included Dr. Wolery as the Principal Investigator and Dr. David Gast as the Co-Principal Investigator.

In July of 1990, the project was moved to the Early Childhood Intervention Program, Allegheny-Singer Research Institute, Pittsburgh, Pennsylvania when the Principal Investigator, Mark Wolery, changed employment (Grant No changed to: HO23C00125).

Thus, the first year of the project was completed while Dr. Wolery was at the University of Kentucky, and the second and third years were completed while Dr. Wolery was at Allegheny-Singer Research Institute. During the last two years of the project, Dr. Wolery served as the sole Principal Investigator.

Origins and Conceptual Foundation of Project LEARN

Project LEARN grew out of our previous research on two other Field-Initiated research projects (Comparison of Instructional Strategies [Project CIS], Grant No. G008730215; Mark Wolery was Principal Investigator and David L. Gast was Co-Principal Investigator, and Group Errorless Teaching Strategies [Project GETS], Grant No. GOO8730215; David L. Gast was the Principal Investigator and Mark Wolery was the Co-Principal Investigator). In those projects, we approached instruction as a task of establishing stimulus control. We were specifically interested in a set of procedures called response prompting procedures (e.g., time delay, system of least prompts, mand-model procedure) (Wolery, Ault, & Doyle, 1992). These procedures were systematic strategies for transferring stimulus control from teachers' prompts to natural or target stimuli. We have continued to use the principles of stimulus control as the conceptual base for the research conducted on Project LEARN.

In our original research on Project CIS, we compared a number of direct instructional strategies (e.g., constant and progressive time delay, the system of least prompts, etc.) (cf. Ault, Wolery, Doyle, & Gast, 1989), and in Project GETS, we applied those strategies in small group contexts (Collins, Gast, Ault, & Wolery, 1991). In the comparison studies, we analyzed the effectiveness and efficiency of the strategies. We defined effectiveness as whether children acquired the behaviors that were taught directly (i.e., Did children learn?). We defined efficiency as the relative value of one strategy over another to which it was compared (i.e., Does one strategy result in superior learning to another?). We recognized that efficiency had two components: To be called "efficient" a strategy had to (a) result in learning (i.e., be effective), and (b) result in superior learning than some other strategy. Initially, we operationalized the second component of efficiency (i.e., superiority) as whether one strategy resulted in more rapid learning. Specifically, we measured whether one strategy resulted in fewer sessions, fewer trials, fewer minutes of instruction, and in less errors and lower error percentages to criterion than another strategy. We reasoned that if both strategies were effective (i.e., resulted in children achieving criterion), then one strategy might be more efficient (i.e., result in more rapid learning). Indeed, we found that some instructional strategies (e.g., constant time delay) produced more efficient (rapid) learning than other strategies (e.g., system of least prompts).

In that research, we were teaching students the objectives from their IEPs in direct instructional contexts, initially in one-on-one (individual) instructional formats and later in small group arrangements. However, we occasionally encountered students who were not learning despite the fact that behaviors being taught were appropriate to their skill levels, the strategies being used had been effective with a broad range of learners and skills, and the strategies were being used correctly by the teachers. We discovered that if we required children to attend to the critical features of the stimuli, then they would often begin to respond correctly. For example, if a student was being taught to read sight words but was not acquiring them, we could make a slight change in the trail sequence by asking students to name the letters of the word before responding. This amount to adding an active attentional response before the children responded. The active attentional cue often resulted in children performing correctly and achieving criterion. After having used the active attentional response (i.e., saying the letters of the word before being asked to read the word), we asked, "Would children learn to spell the word from having said the letters during instruction on word reading?" Interestingly, they often did.

This finding lead us to reconceptualize our definition of efficiency; specifically, we recognized that two strategies could be effective and have similar outcomes in terms of the rapidity of learning (i.e., similar number of sessions, trials, minutes of instruction, and errors to criterion), but one strategy might result in children acquiring behaviors other than those directly taught (e.g., the spelling of the words from the attentional cue). Thus, the superiority component of efficiency could be defined on at least two levels: (a) The extent to which both strategies influenced the rapidity of learning, and (b) the number of behaviors learned (i.e., those directly taught and those learned incidentally - not directly taught but acquired as a result of the instruction). In thinking about efficiency in this way, we asked, "Where in the trial sequence of direct instructional sessions could we 'add in' extra behaviors that children might learn without direct instruction on those behaviors? Two points in the trial sequence appeared relevant: (a) the attentional cues as described above, and (b) the consequent events for students responding (i.e., in the feedback provided for responses such as praise statements). This reconceptualization of efficiency lead to the development of the application for Project LEARN. Initially, we were interested in whether adding "extra," non-target stimuli to the trial sequences (i.e., either at the antecedent portion or consequent events portion) would result in children acquiring those stimuli, thereby making the strategies more efficient.

In searching for a conceptual base in other investigators' work for the reconceptualization of efficiency, we found two old and well established phenomena from which to work; these were: observational learning and incidental learning. Observational learning, of course, refers to the acquisition of behaviors that the learner sees others do. In the studies we proposed for Project LEARN, the extra, related, non-target stimuli were often performed by the teacher; thus, the student could acquire it by observing and imitating the teacher's model. In other studies, the extra stimuli were present in the instructional context but not performed by the teacher; however, the student could acquire them through incidental learning.

Objectives of Project LEARN

In our original application for Project LEARN, we listed four objectives. Three of these objectives focused on studies to be conducted and one focused on the development of dissemination products. We proposed 12 studies over the three years of the project, and we proposed two manuals and one instructional module. Although not proposed as an objective, we planned to disseminate the information from the project through presentations at professional conferences. The objectives of the project were as follows:

Objective 1. To conduct and report on four investigations that evaluate the acquisition and generalization of (a) target behaviors and (b) related, non-target behaviors presented in antecedent events (attentional/orienting cues and responses) by students with mild and moderate handicaps.

Objective 2. To conduct and report on four investigations that evaluate the acquisition and generalization of (a) target behaviors and (b) related, non-target behaviors presented through descriptive feedback (i.e., consequences for correct and incorrect responses) by students with mild and moderate handicaps.

Objective 3. To conduct and report on four investigations that compare the acquisition and generalization of related, non-target behaviors that are presented through descriptive feedback and/or antecedent events by students with mild and moderate handicaps.

Objective 4. To write two manuals and one instructional module that describe how to use (a) antecedent events to facilitate acquisition of related, non-target behaviors, and (b) consequent events to facilitate acquisition of related, non-target behaviors.

The presentation of the related, non-target behaviors in the antecedent manipulations involve the following guidelines. First, the students would be presented with a model of the related, non-target stimuli or some other attending cue before they responded to the target stimulus. Second, students would not be reinforced for responding correctly to the related, non-target stimulus during instruction - beyond the reinforcement that might occur due to the progression of the trial sequence. Third, students' acquisition of the related, non-target stimuli would be assessed through pre- and post-test probe sessions. The pre-tests would occur prior to instruction on the target behaviors, and the post-tests would occur after students achieved criterion on their target behaviors.

The presentation of the related, non-target behaviors in the consequent manipulations involved the following guidelines. First, the related, non-target stimuli would be presented after students responded to the target stimulus. Second, students would not be required to respond to the related, non-target stimuli that was presented during the feedback events. Third, if students responded to the presentation of the related, non-target stimuli presented during the feedback events, their response would be ignored. Fourth, students' acquisition of the related, non-target stimuli would be assessed through pre- and post-tests. The pre-tests would occur prior to instruction on the target behaviors, and the post-tests would occur after students achieved criterion on their target behaviors.

Accomplishments of Project LEARN

In this section of the report, we discuss five issues. First, we list the accomplishments of the project in relation to the objectives described in the original proposal. Second, we describe the evolution of the project in terms of how our studies shaped subsequent investigations. Third, we provide a brief summary of each of the studies that were conducted on the project. Fourth, a summary listing of the major findings and contributions of the project are included. Fifth, we discuss the dissemination activities from the project.

Accomplishments in Relation to Objectives of Project LEARN

In the original application, we proposed four objectives (as listed above). Objectives 1, 2, and 3 related to conducting investigations, and Objective 4 related to the development of two manuals and an instructional module for dissemination of the project findings. From Objectives 1, 2, and 3, we proposed to conduct 12 investigations, 4 were to address antecedent manipulations (Objective 1), 4 were to address consequent manipulations (Objective 2), and 4 were to be comparative studies related to the manipulations (Objective 3). The studies for Objectives 1 and 2 were not to be comparative studies, but rather, demonstration studies of the effects of antecedent and consequent manipulations, respectively. The studies for Objective 3 were to compare methods of presenting the antecedent or consequent manipulations, or they were to compare antecedent to consequent manipulations.

During the course of the project, we planned and completed 13 investigations. However, the distribution of studies in terms of the original objectives were not as proposed. Specifically, we conducted two investigations that focused only on antecedent manipulations (Objective 1), we conducted five investigations that focused only on consequent manipulations (Objective 2), and we conducted 6 investigations that compared methods of presenting antecedent or consequent manipulations (Objective 3). Thus, we proposed four antecedent manipulation studies, and conducted two; we proposed four consequent manipulation studies and conducted five; we proposed four comparisons studies and conducted six.

For the fourth objective, we proposed to develop and write two manuals and one instructional module. One manual was to describe the antecedent manipulations and the other manual was to describe the consequent manipulations. The instructional module was to be a guide for faculty members and inservice training instructors to use in training prospective and participating teachers to employ both antecedent and consequent manipulations.

During the course of the project, we developed two manuals, one on antecedent manipulations and one on consequent manipulations. In addition, we developed an instructional module. The antecedent manual is presented in Appendix A, the consequent manual is presented in Appendix B, and the instructional module is presented in Appendix C.

Evolution of Project LEARN

As described above, we proposed 12 studies and conducted 13; however, we did not conduct the number of studies for each objective as proposed. For Objective 1, we proposed four studies and conducted two, for Objective 2, we proposed four studies and conducted five, and for Objective 3, we proposed four studies and conducted six. The reasons for this adjustment are described in this section.

Four factors resulted in our adjustment of the nature of the studies over the course of the project. First, we conducted or guided the implementation of studies that were not funded on Project LEARN but were related directly to the questions and manipulations being studied on Project LEARN. We were able to do this primarily through student research (e.g., student thesis research). We have participated in ten studies related to antecedent manipulations, and we have participated in 22 studies related to the consequent manipulations - several of which were comparison studies. Thus, while we proposed to do 12 studies we actually conducted 13 studies on Project LEARN, we also had the results of more than 30 studies to guide our thinking about the questions and phenomenon being studied on Project LEARN.

Second, from all the studies of the antecedent manipulations, we found that they tended to be restrictive in terms of the content inserted into the attentional cues. Several of the antecedent manipulation studies focused on teaching sight word reading as the target behaviors and used spelling as the related non-target stimuli. In other words, before the child was asked to read the word, they were asked to say the letters of in the word. However, in the other studies that did not use spelling as the related, non-target information, we found it difficult to identify content (stimuli) were the antecedent manipulation could be used. In a couple of cases, the antecedent manipulations appeared to interfere with the students' learning. While the antecedent manipulations are quite appropriate and useful for increasing the efficiency of some direct instructional programs, it appeared limited in the content where it was easily and appropriately used. Similarly, we had little difficulty adding related, non-target stimuli to the consequent events. A broad array of stimuli (content) could be added into the consequent events of trials. Thus, we concluded that the consequent manipulations may have broader application, and therefore, we devoted more of our research efforts into studying the consequent rather than antecedent manipulations.

Third, throughout our research, we have relied on teachers' feedback about the manipulations we were studying. In nearly all of our research (including Project LEARN, other funded projects, and our student research), the children's classroom teachers have implemented the instructional sessions rather than our research staff. As a result, we had a rich source of information about the ease with which our manipulations could be implemented, and about their general perceptions of the value of the manipulations. Almost without exception, teachers provided positive feedback about the consequent manipulations (i.e., adding extra, related, non-target stimuli to the feedback following children's responses). They suggested that it was relatively easy to implement and that it fit naturally into their teaching styles. Further, data on their implementation confirmed their verbal statement; that is, they consistently and correctly carried out the consequent event manipulations. However, with the antecedent manipulations, some teachers were less enthusiastic. It did not fit as well into their teaching styles, although they implemented it reliably. Thus, we concluded that the manipulations of the consequent events had a greater probability of finding its way into daily use by teachers.

Fourth, in one of our studies in the 01 Project Year, we compared two instructional conditions: in one condition, the children were taught to name a set of photographs and were shown the written word for the photograph name in the consequent events (i.e., during praise statements); in the second condition, they were taught to name a second set of photographs but were not shown the written word for the photograph name. After they learned to name both sets of photographs from both conditions, they were taught to read the words for the names of both sets of photographs. Thus, they were taught to read the words they had been shown during photograph naming instruction and the words for the photographs they had not been show. As expected, the students learned the words they had been shown through the consequent manipulation of photograph naming more rapidly than the words they had not been shown. Thus, it appeared that presenting the stimuli of future target behaviors (those to be taught directly later) through the consequent events for current instructional targets, the efficiency of the future instruction could be enhanced substantially. We concluded that this manipulation may result in a major improvement in the efficiency of direct instruction. Thus, we devoted one study in each of the 02 and 03 Years to this line of research. These studies by their very nature were comparative studies.

Taken together, these four factors caused us to adjust our initial plans. Three adjustments occurred. First, we decreased the number of demonstration studies devoted to antecedent manipulations from four to two. Second, we increased the number of demonstration studies with the consequent event manipulation from four to five. Third, we increased the number of studies devoted to comparisons from four to six.

As the various studies were completed, presented, and submitted for publication, we secured a greater understanding of the manipulations that we were studying. In attempting to add extra, related, non-target stimuli to the attentional cues, we realized that there were many ways to classify attentional cues. As a result, we developed a taxonomy of attentional cues. This taxonomy is presented in the antecedent manipulation manual (Appendix A).

In terms of adding related, non-target stimuli to the consequent events, two important developments occurred. First, reviewers and other professionals did not readily accept our interpretations of the mechanisms causing the students to learn the related, non-target behaviors. They said it did not fit the traditional incidental learning paradigm as studied by learning theorists (e.g., Stevenson, 1972), because we presented the stimuli directly to the students (although they were not required to respond to it and were not reinforced for doing so), and because we pre-tested students on the stimuli which may have sensitized them to learn it. Also, they suggested that it could be explained as a form of observational learning. It was different, however, from the traditional observational learning paradigm (e.g., Bandura, 1977) because it was presented directly to the learner (i.e., observer), and the observer never had the occasion to see the model being reinforced for doing the behavior. Reviewers also suggested that the addition of the related, non-target stimuli in the consequent events was a unique form of feedback. As a result, we developed a descriptive name for the consequent manipulation of adding related, non-target stimuli; specifically, we have come to call it "instructive feedback." Although this name does not describe the mechanisms that cause children to learn it, it does communicate with others the nature of the manipulation.

Specifically, the manipulation provides the learner with instruction (i.e., is instructive) and that instruction occurs in the consequent events of the trial sequence (i.e., is feedback).

The second development involved construction of a system for classifying the instructive feedback stimuli (i.e., the extra, non-target stimuli presented during the consequent events). Across studies we noted that we had used three categories of stimuli, which we have come to call (a) expansions, (b) parallel, and (c) novel. Instructive feedback stimuli that are expansions are from the same curricular domain and extend the concept that is being taught in the target behavior; for example, if the target behavior is sight word reading, then the instructive feedback stimuli might be the definition of the word. Instructive feedback stimuli that are parallel are those that require the same response as the target behavior; for example, if the target behavior is naming the number of objects in a set, then the instructive feedback stimuli might be the numeral for the quantity in that set or the written word for that quantity. Instructive feedback stimuli that are novel are those that are not from the same curricular domain and are not conceptually related to the target behaviors; for example, if the target behavior is to teach the child the name of a shape, then the instructive feedback stimuli could be the color of that shape.

Summary of Studies on Project LEARN

In this section, we present a brief abstract of the 13 investigations conducted on Project LEARN. The two demonstration studies with the antecedent manipulation are presented first; these are followed by the five demonstration studies of the consequent manipulation; and these are followed by the six comparisons studies, five of which focused on consequent manipulations and one of which focused on an antecedent manipulation. For studies that have been disseminated, a copy of the full report is contained in the Appendices.

Study # 1 - Antecedent Manipulation - Varying the attentional cues: Acquisition of related, non-target information.

The purposes of this study was to evaluate whether preschool children with developmental delays would acquire photograph naming taught with constant time delay when one related, non-target stimulus was added in the attentional cue for each photograph and when two related, non-target stimuli were added in the attentional cue for each photograph. The related non-target stimuli were statements about the photographs being taught. The children were initially assessed on multiple sets of photographs, and then instruction was provided on each set sequentially in a small group arrangement. A multiple probe design across sets of photographs and replicated across subjects was used to evaluate the procedures (Tawney & Gast, 1984). The results indicated that (a) three of the five students acquired the photograph names when one related, non-target statement was added to the attentional cue of the trial statement for their photographs; (b) three of the five students acquired some, but not all, of the related, non-target statements for their own photographs and for the photographs taught to their peers when one statement was used for each photograph; (c) three of the five students acquired the photograph names when two related, non-target statements were added to the attentional cue in trial sequences for their photographs; (d) three of the five students acquire some, but not all, of the related, non-target statements for their own photographs and the photographs taught to their peers when two related, non-target statements were provided for each photograph; and (e) the two children, who did not initially acquire the photograph names when one non-target statement for each photograph was provided, did acquire the photograph names when taught separately without additional information in the antecedent statement. These findings indicate that for some children the addition of related, non-target statements in the attentional cue of trial sequences results in acquisition of the target behaviors and of the statements in the attentional cues; however, the statements in the attentional cues may interfere with the acquisition of target behaviors for others students. Thus, teachers are encouraged to provide children with histories of direct instruction without related, non-target behaviors presented in the attentional cues before attempting to use the antecedent manipulation.

Study # 2 - Antecedent Manipulation - Triadic Instruction of Chained Food Preparation Responses: Acquisition and Observational Learning.

The purposes of this study were to determine (a) whether constant time delay would be effective in teaching students with moderate mental retardation in triad to perform chained tasks, and (b) whether observational learning would occur if only one student was taught at a time and that student provided antecedent attentional cues to the observers. Three chained snack preparation tasks were identified, and each student was directly taught one task. The other two students observed the instruction. The instructed student told the observers to watch and to turn pages of a pictorial recipe book (i.e., antecedent manipulation). The teacher provided frequent praise to the instructed student based on performance and to the observers for watching the instruction and turning the pages. A multiple probe design across students and tasks was used to evaluate the instruction. The results indicated that each student learned the skill they were taught directly, and the observers learned nearly all of the steps of the chains they observed. This study indicates that the addition of antecedent cues from the instructed student to the observers in the context of constant time delay instruction on response chains resulted in both the instructed and observer students learning the response chains that were taught. The study demonstrates an efficient means of teaching response chains to multiple students without having to provide instruction to each student directly. Thus, teachers are encouraged to adopt this method when more than one of their students needs to learn the same response chain.

This study was accepted and published in the Journal of Applied Behavior Analysis, 25, 193-204. A copy of the published article is presented in Appendix D.

Study # 3 - Consequent Manipulation - Effect of Independent and Interdependent Group Contingencies on Acquisition, Incidental Learning, and Observational Learning.

The purpose of this study was to evaluate the effects of two contingencies (independent and interdependent) on the learning of students with learning and behavioral disabilities when conducted in small groups with constant time delay and when instructive feedback stimuli were presented. Eight students participated in the study; seven were taught four sets of behaviors and one was taught two sets. Measures were collected on the rapidity with which children learned under the two contingencies, the amount of observational learning that occurred, and the extent to which students acquired additional information that was included in the feedback for correct responses (i.e., instructive feedback). In this study, two instructive feedback stimuli were presented for each target behavior. A single subject design (adapted alternating treatments design) was used to evaluate the effects of the two contingencies. The results indicate that (a) both instructional arrangements were effective with all students and all behaviors; (b) the independent contingency condition resulted in more rapid learning than the interdependent contingency; (c) students acquired nearly all of the behaviors taught to their group members (observational learning), but it was not differentially affected by the two contingencies; and (d) students acquired some of each type of instructive feedback stimuli (incidental learning), but it also was not differentially affected by the two contingencies despite the fact that one type was learned at higher levels than the second type. Thus, teachers are encouraged to use instructive feedback that may involve two stimuli for each target behavior; however, such use is likely to result in different levels of learning. Teachers also are encouraged to use independent rather than interdependent group contingencies in instructional arrangements similar to those used in this study.

This study has been submitted for publication. A copy of the submitted article is presented in Appendix E.

Study # 4 - Consequent Manipulation - Effects of Instructive Feedback Rule Statements on Acquisition and Generalization.

This study was designed to evaluate the effects of stating a rule through instructive feedback on students' acquisition and generalization of spelling words. The rules presented through instructive feedback could be used to spell the target words. Two pools of words were selected and each word followed one of two rules (i.e., "to make it more than one, change 'y' to 'i' and add 'es'" and "to make it more than one, change the 'f' to 'v' and add 'es'"). Each pool of words following a given rule were divided into two sets. Seven elementary school children with learning disabilities were taught to spell the sets of words in small group instructional arrangements. The children were divided into two groups. One group was taught a set of "ies" words with the rule statement presented through instructive feedback and was taught a set of "ves" words without the rule statement. The second group was taught a set of "ves" words with the rule statement presented through instructive feedback and was taught a set of "ies" words without the rule statement. After acquisition of both sets of words, children were assessed on their abilities to read two untaught sets of words (one "ies" set and one "ves" set). They were subsequently taught these words without rule statements. The results indicated that (a) all children learned to spell all the words that were taught directly; (b) after training on one set of words, children spelled more new words that followed the rule that had been stated through instructive feedback than new words that followed the rule that had not been stated; and (c) subsequent instruction of the new sets of words following the two rules consistently resulted in the "ies" words being learned more quickly than the "ves" words regardless of whether the rule had been presented previously. These findings indicate that statement of a spelling rule through instructive feedback may promote generalization to untaught words that follow the same rule. However, it is not possible from this study to determine whether statement of the rule through instructive feedback will result in more rapid learning of other similar words when the rule is not stated because the two pools of words (i.e., the "ies" words and "ves" words) were not of equivalent difficulty. Thus, teachers are encouraged to use the rule statements in instructive feedback when teaching rule-based behaviors; however, further research is needed before the merits of such use are fully understood.

Study # 5 - Consequent Manipulation - Efficacy of Transition-Based Teaching with Instructive Feedback.

The efficacy of implementing a small number of transition-based teaching trials with instructive feedback was investigated to determine whether preschool students with hearing impairments would acquire pre-academic skills. Trials to teach naming of shapes were dispersed throughout the day with one trial per child in a transition from one classroom activity to another. The teachers provided the instructive feedback (colors of the shapes) in praise statements following correct responses. Students were assessed to determine whether they could generalize these skills to other materials. The results indicate that the constant time delay procedure delivered during transitions was effective in establishing acquisition of preacademic skills, and all students were able to generalize some shape names to materials other than the training stimuli. Additionally, all students generalized some of the color names although no direct instruction occurred on these stimuli. Thus, teachers are encouraged to use transition-based teaching and to include instructive feedback in that instruction.

This study has been submitted and accepted for publication by Education and Treatment of Children. A copy of the article is presented in Appendix F.

Study # 6 - Consequent Manipulation - Stimulus Equivalence Established Through Instructive Feedback.

Three experiments were conducted to determine whether a stimulus class would emerge as a result of one conditional discrimination training (implemented with constant time delay) augmented with instructive feedback. Five middle school-aged students enrolled in a class for emotional support participated in the studies. The students were taught to identify fractions and their equivalents in lowest form and multiplied by factors. The results indicated that, after modifications in the placement of the lowest form of the fraction, the students were able to form a stimulus class. This was accomplished with minimal number of trials and training time, near errorless learning, and in a classroom setting with group instruction. Repeated probing strengthened the relationships. It should be noted that the establishment of stimulus equivalence through instructive feedback was greatest in this investigation when the instructive feedback stimuli were less complex than the target behaviors and when students had a history of the testing requirements and instruction with instructive feedback.

This study has been submitted for publication and is currently under review. A copy of the completed manuscript is found in Appendix G.

Study # 7 - Consequent Manipulation - Effects of Simultaneous Prompting and Instructive Feedback.

This study evaluated the use of simultaneous prompting with instructive feedback regarding classification of the target stimuli during praise statements on children's ability to receptively identify Rebus symbols and subsequently to classify those stimuli. Five, 3-year-old children with disabilities participated, and a multiple probe design across sets of behaviors was used to evaluate the simultaneous prompting strategy and instructive feedback. The results indicate that (a) the simultaneous prompting strategy was used reliably, (b) all children learned to identify all symbols that were taught, (c) children acquired the second and third sets more rapidly than the first set of stimuli, (d) some of the children acquired the classification information presented through instructive feedback, and (e) generalization across stimulus size occurred for all of the children (three) for whom it was assessed. Thus, it appears that the instructive feedback information can be on "higher order" skills (i.e., classification) not solely on discrete responses. While teachers are encouraged to use instructive feedback for such skills, substantial research is needed before definitive recommendations can be made.

This study was submitted and accepted for publication by Early Education and Development. A copy of the completed manuscript is presented in Appendix H.

Study # 8 - Comparison Study - Effects of Active and Inactive Attentional Cues on Acquisition and Generalization.

The purpose of this study was to compare the effects of active versus inactive attentional responses in teaching children to read words in a small group context with constant time delay. Children were taught six sets of words; three sets were taught with an active attentional cue that involved watching the teacher write the word and having the child write the word (active), and three sets were taught with the child watching the teacher write the word (inactive). The results indicated that (a) all children learned to read the words; (b) the active attentional cue resulted in acquisition of more correct spelling of the words than the inactive attentional cue; (c) the mean session length with the active attentional cue was consistently longer than the mean session length with the inactive attentional cue. These results indicate that the addition of an active attentional cue may result in children acquiring the content (in this case, spelling) of the active attentional cue. However, when the active attentional cue was used, the session length was consistently longer, and may have been sufficiently long to teach the spelling directly. Thus, teachers should be careful not to use active attentional cues/responses that will substantially extend the session length.

Study # 9 - Comparison Study - Effects of Presenting Incidental Information in Consequent Events on Future Learning.

The effects of presenting future target stimuli in the consequent event following correct responses to current target stimuli were examined in two experiments teaching eight students with moderate handicaps to name photographs. In Experiment I, progressive time delay was used to teach two sets of photographs. During instruction, correct responses to one set of stimuli resulted in praise and presentation of the printed word for the person in the photograph (future condition). In the second set, a correct responses was followed by praise alone (non-future condition). After establishing criterion level performance on both sets of photographs, students were taught to read the printed word from each of the two sets. Experiment II was a systematic replication of Experiment I. Four students from a different classroom also were taught to name two sets of photographs. An adapted alternating treatments design was used in each experiment. The results indicated that (a) all students learned to name the photographs; (b) presentation of future target stimuli (words) in consequent events resulted in seven of the eight students learning to read some of the words; and (c) the total number of sessions, trials, errors, and percentage of errors needed to teach students four photographs and four words were lower for the future condition than the non-future condition. These results suggest that teachers should include instructive feedback stimuli that will be taught later, given, of course, that the future and current stimuli result in the same response.

These two experiments were described in one manuscript. The manuscript was accepted and has been published in the Journal of Behavioral Education, 1, 79-104. A copy of the published article is shown in Appendix I.

Study # 10 - Comparison Study - Increasing the Efficiency of Future Learning Through Instructive Feedback.

This study investigated the effects of presenting future target behaviors in the consequent event following correct responses of current target behaviors when teaching preschoolers in a small group arrangement to name numerals. A 3-second constant time delay procedure was used to train two sets of numerals. During instruction, correct responses to one set of numerals received a token, verbal praise, and presentation of the printed number word for the targeted numeral in one daily session. In the other daily session, the second set of numerals received only tokens and verbal praise. After criterion was met on both sets of numerals, children received instruction on number words corresponding to numerals in each of the previously instructed sets. An adapted alternating treatments design (Sindelar, Rosenberg, & Wilson, 1985) was used to compare the effectiveness and efficiency of the two conditions. Results indicate that (a) all children learned to name numerals in both conditions, (b) presentation of future target behaviors did not interfere with learning of numerals, (c) four of five children learned to read all number words in both conditions, and (d) the addition of number words during numeral instruction increased the rapidity with which children acquired the number words. In this study, the use of instructive feedback during "current" instruction resulted in a substantial saving of instructional time when the instructive feedback stimuli were taught directly. Thus, teachers are strongly encouraged to analyze their curriculum for skill sequences where multiple stimuli result in the same response. Whenever such behaviors exist, the use of instructive feedback is recommended.

This study has been submitted for publication and is currently under review. A copy of the complete manuscript is shown in Appendix J.

Study # 11 - Comparison Study - Effects of Instructive Feedback on Future Learning.

This study evaluated the effects of presenting instructive feedback for current target behaviors when teaching preschoolers in dyads to name four stimulus variations: (a) the numerical value of sets of geometric figures, (b) the corresponding numeral, (c) the corresponding number word, and (d) the corresponding Roman numeral. Selected behaviors for each of the four types of stimuli were divided into two sets and instructed with a 3-second constant time delay procedure. During instruction, correct responses to one set of behaviors received a token, verbal praise, and presentation and verbal description of the future target stimuli for the currently instructed stimuli in one daily session. In the other daily session, the second set of stimuli received only tokens and verbal praise. After criterion was met on naming the numerical value of sets of geometric figures, children received instruction on naming numerals, followed by instruction on naming number words. A parallel treatments design (Gast & Wolery, 1988) was used to compare the effectiveness and efficiency of the two conditions. Results indicate that: (a) three of the four children learned all future behaviors, (b) presentation of instructive feedback did not interfere with learning current target behaviors, and (c) in terms of direct instruction time required by the teacher, future behaviors were acquired more efficiently. The use of instructive feedback in this study resulted in considerable savings of instructional time. Thus, teachers are strongly encouraged to use instructive feedback when sequentially taught stimuli have the same response.

This study has been submitted for publication and currently is under review. A copy of the complete manuscript is presented in Appendix K.

Study # 12 - Comparison Study - Effects of Instructive Feedback Related and Unrelated to the Target Behavior.

Two studies were implemented to compare the acquisition of stimuli that were related and unrelated to the target stimuli being taught. A constant time delay procedure with instructive feedback was used. Five students, ages 9 and 10 years and enrolled in a class for students needing emotional support, were participants. The teacher used a massed trial format to teach two conditions on alternating days, one with related and one with unrelated instructive feedback. The results of the first experiment indicated that (a) all children learned the target behaviors, and (b) all students learned more of the unrelated instructive feedback stimuli. In the second experiment the procedures were repeated, reversing the academic domains of the related and unrelated stimuli. The results indicated that (a) all students learned the target behavior, and (b) 4 of the 5 students learned an equal amount or more of the related instructive feedback stimuli. The implications of considering novelty, interest, and difficulty of instructive feedback stimuli are discussed. These findings suggest that a conceptual relationship between the instructive feedback stimuli and the target stimuli is not required. However, the study raises substantial questions about the characteristics of the instructive feedback stimuli (e.g., difficulty, children's prior knowledge of the stimuli, children's interest in the stimuli, etc.). Until the effects of such issues are studied, it is difficult to form precise recommendations to teachers concerning the selection of instructive feedback stimuli.

These two studies were described in one manuscript. It has been submitted for publication and is currently under review. A copy of the complete manuscript is found in Appendix L.

Study # 13 - Comparison Study - Instructive Feedback: A Comparison of Simultaneous and Alternating Presentation of Non-Target Stimuli.

Instructive feedback involves presenting extra, non-target stimuli in the consequent events for children's responses. Two methods of presenting instructive feedback during direct instruction were compared. These methods involved presenting two extra stimuli on all trials, and presenting the two extra stimuli separately on alternating trials. Preschool students were taught coin combinations using a constant time delay procedure with instructive feedback stimuli added to both praise and correction statements. An adapted alternating treatments design was used to evaluate the two methods of presenting instructive feedback. The students were assessed to determine the extent to which instructive feedback stimuli were learned. The results indicate that students learned some of the instructive feedback stimuli and no consistent differences in the effectiveness of the two presentation methods were noted. Further, relationships between the two instructive feedback stimuli appeared to be established. Thus, the findings of this study suggest that teachers can present at least two instructive feedback stimuli for each target behavior being taught, and that the manner in which the two are presented (i.e., simultaneously on all trials or separately on alternating trials) does not appear to influence the amount of acquisition of those stimuli. In fact, the amount of acquisition may be more related to the difficulty of the instructive feedback stimuli in relation to the target stimuli than to the mode of presentation; however, additional research in this area is needed.

This study has been accepted for publication by the Journal of Behavioral Education. A copy of the complete manuscript is shown in Appendix M.

Findings and Contributions of Project LEARN

From the Project LEARN investigations and from related studies in which we have participated, a dozen conclusions can be made about the use of instructive feedback (i.e., addition of extra, non-target stimuli in the consequent events for students' responding). These are listed below:

1. When instructive feedback has been used (a) with response prompting strategies, (b) in direct instruction, (c) with identified reinforcers, (d) with multiple target behaviors being taught simultaneously, (e) with delivery of the instructive feedback following each correct child response, (f) with only pre- and posttest assessment, and (g) with consistent and static presentation of the instructive feedback stimuli, then students acquire some, if not all, of the instructive feedback stimuli.
2. This finding (i.e., # 1 above) has occurred for (a) preschoolers with developmental delays, moderate mental retardation, and hearing impairments; (b) elementary-aged children with learning disabilities, behavior disorders, mild mental retardation, and moderate mental retardation; and (c) adolescents with moderate mental retardation and behavior disorders.
3. The types of behaviors taught in the instructive feedback studies are presented in Table 1; as shown, a range of behaviors have been successfully acquired.

Table 1

The Target and Instructive Feedback Stimuli Taught in Instructive Feedback Studies

Target	Instructive Feedback
Naming number sets	Naming numerals
Naming numerals	Reading number words
Naming coin values	Number words, numerals
Matching factions	Matching equivalent fractions
Naming photographs	Reading words
Reading words	Stating a definition
Reading words	Spelling those words
Stating facts	Stating related facts
Naming photographs	Stating information about photos
Naming shapes	Stating color of shapes
Identification of Rebus symbols	Classification of symbols
Stating antonyms	Reading word, definitions

4. Acquisition of instructive feedback stimuli has occurred in a variety of instructional arrangements, including (a) one-to-one instruction, (b) small group instruction (3-5 students), (c) transition-based teaching, and (d) computer-assisted instruction.

5. Teachers of preschool, elementary, and secondary students have implemented the instructive feedback procedure correctly during direct instructional sessions, and teachers of preschool children have implemented it reliably in transition-based teaching arrangements.

6. Instructive feedback stimuli have been presented verbally (i.e., teacher says it), visually (i.e., on cards or photographs), verbally and visually (teachers says it while showing a card/picture), and verbally and through manual sign (i.e., through total communication).

7. Instructive feedback stimuli have been acquired (a) when one instructive feedback stimulus is presented for each target behavior; (b) when two instructive feedback stimuli are presented for each target behavior either simultaneously on each trial or separately on alternating trials (however, the difficulty and whether children have a referent for the instructive feedback stimuli may influence the occurrence and amount of acquisition); and (c) when the instructive feedback stimuli are related (within the same curricular domain) or unrelated (in a different curricular domain) to the target stimuli.

8. When the instructive feedback stimuli involve behavior that will taught directly in the future (i.e., parallel instructive feedback stimuli), students learn the "future" target behaviors that were presented through instructive feedback more rapidly than similar target behaviors that were not presented through instructive feedback; however, all studies of this issue have involved the same response to various forms of the stimulus).

9. Use of instructive feedback does not appear to interfere with the rapidity with which target behaviors are acquired, or to increase substantially the length of instructional sessions.

10. In small group instruction, students sometimes acquire a portion of their peers' target and instructive feedback stimuli.

11. Use of specific attending cues (e.g., asking children to repeat the task direction) as compared to general attending cues (e.g., asking them to look at the target stimulus) appears to increase the probability of students learning their peers' instructive feedback stimuli.

12. When instructive feedback is structured such that equivalent relationships can be established and tested, stimulus classes are sometimes formed -- particularly, if the instructive feedback stimuli are less complex or less difficult than the target stimuli.

Although we have learned a great deal about how to use instructive feedback, there are many unanswered questions for subsequent research. These include issues related to the presentation of the instructive feedback, issues in selecting instructive feedback stimuli, issues related to promoting observational learning of the instructive feedback stimuli shown to children's peers, issues related to promoting generalization of the instructive feedback stimuli across stimulus formats, and issues related to the use of instructive feedback to establish stimulus equivalence.

From our research on Project LEARN and other studies that added the extra, non-target stimuli to the antecedent portion of the trial, the following findings can be stated:

1. During direct instruction, if children (a) are not acquiring the target behaviors, (b) the target behaviors are within the range of appropriate skills (i.e., the children have the prerequisites for the skill), and (c) reinforcers are being used, then use of an attentional cue

and response that provides additional information and focuses attention on the distinctive features of the target stimulus may result in children acquiring the target behaviors and in some cases acquisition of the additional stimulus.

2. When teaching sight word reading to preschool and elementary-age children, having them (a) repeat the letters of the words after the teacher names them but before the teacher asks them to read the word, (c) say the letters of the word without a teacher model before the teacher asks them to read the word, and (d) writing the letters in order from a visual model before being asked to read the word will result in students learning to spell the words as well as read the words.

3. Active attentional responses (e.g., writing a word before reading it) as compared to inactive responses (e.g., watching the teacher write it) may result in more acquisition of the additional stimuli (i.e., spelling), but also results in longer instructional sessions.

4. The addition of extra, related, non-target stimuli in the antecedent portion of trials may interfere with acquisition of the target response when children do not have a history of direct instruction.

In addition to the findings listed above from the investigations, we also made other contributions to the field in terms of the use of non-target stimuli presented in the antecedent portion of trial sequences and through instructive feedback. First, we developed a model for analyzing attending cues. This model is presented and discussed in the manual on antecedent manipulations (see Appendix A).

Second, much of the research that studied the antecedent manipulations and the use of instructive feedback involved the constant time delay procedure. As a result, we conducted, submitted, and published an extensive literature review of the constant time delay procedure (Wolery, Holcombe, et al., 1992). This paper is presented in Appendix N.

Third, to communicate the findings from the research on instructive feedback, we wrote a "how-to" article for teachers. This article has been submitted for publication. A complete copy of the manuscript is presented in Appendix O.

Dissemination of Project LEARN Findings and Products

To disseminate our findings we have used six mechanisms: (a) write, submit, and publish reports of the studies in the professional literature, (b) write manuals for use by students who are in teacher training programs and for use by practicing teachers, (c) write an instructional module for use by faculty members in teacher preparation programs and for use by inservice training programs, (d) write an article that describes how to use instructive feedback for practitioners, (e) write review articles that summarize the findings of the investigations, and (f) present the results of the project research and findings at professional conferences. The results of these dissemination activities are presented below.

In terms of writing, submitting, and publishing reports of the research, the following activities have occurred. We have written and submitted ten manuscripts that reported the results of our studies. Of these, two have been published, three are in press, and five are currently under review.

In terms of writing manuals for use by students and practicing teachers, we proposed to write two manuals and we have done so (see Appendices A and B). These manuals have been disseminated to about 100 individuals who are (a) on our mailing list of persons who show an interest in our research, and (b) who attended conferences where we presented information on the project.

In terms of writing an instructional module for use by faculty members in teacher preparation programs and for use by inservice training programs. We have written the module (see Appendix C) and have mailed it to about 40 individuals who prepare teachers.

Also, as noted above we have written one "how-to" article and one review article. The article for practitioners has been submitted for publication, and the review article has been published (see Appendices N and O). In addition, although not supported by Project LEARN, we are in the process of writing a literature review on instructive feedback. This manuscript will be submitted for publication in the professional literature.

In terms of conference presentations, we have presented the results of selected studies at the following conferences: The 1991 and 1992 meetings of the Association for Behavior Analysis, the 1990 and 1991 meetings of the Division for Early Childhood of the Council for Exceptional Children, the 1990 meeting of the American Psychological Association, the 1990 meeting of the Association for Persons with Severe Handicaps, the 1991 summer OSERS Research Directors' meeting, and the 1992 Ohio State University conference on Applied Behavior Analysis in Education. In addition, we have presentations scheduled for the 1992 meeting of the Division for Early Childhood of the Council for Exceptional Children. In addition, we have conducted workshops for teachers in Arizona, Florida, Kentucky, Louisiana, Montana, North Carolina, Ohio, Pennsylvania, and South Carolina.

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Appendix A

Antecedent Manipulation Manual

(Manual for dissemination is spiral bound)

Instructive Feedback:

Increasing Opportunities for Learning Through the Addition of Incidental Information

Margaret Gessler Werts

Mark Wolery

Ariane Holcombe

1991

Learning Efficiently: Acquisition of Related Non-Target Behaviors

(Project LEARN)

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Instructive Feedback

Increasing Opportunities for Learning Through the Addition of Incidental Information

Margaret Gessler Werts, Mark Wolery, and Ariane Holcombe

1991

Purpose of the Manual

This manual is designed to be used by practicing teachers, students who are learning to become teachers, and faculty members who instruct such students. Our intent is to disseminate information from our research to as many individuals as possible; therefore, we give permission for users to reproduce the document and to use it, in whole or in part, in the training and research activities. We request that any reproductions maintain the authorship of the manual, and that it contain an acknowledgement and disclaimer that the manual was developed by U.S. Department of Education, Grant Number HO23C00125.

Description of the Manual

This manual contains several sections: (a) background and description of instructive feedback, (b) description of the steps involved in planning and using instructive feedback, (c) two case studies describing the use of instructive feedback, (d) summary statements of the research on which the manual is based, (e) a self-test to allow readers to determine whether they have acquired the content in the manual, (f) references for the literature that is cited, and (g) a list of the studies that used instructive feedback.

Acknowledgements

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Instructive Feedback

Increasing Opportunities for Learning Through the Addition of Incidental Information

"Two for One!" "Second item at reduced price!"

These words mean opportunities for bargains and most of us are delighted to find a bargain. As teachers, would you be interested in teaching one thing and having your students learn "two for one"? Think about how much more you could teach in one year! Think about the time you could save for other activities, other curriculum areas, and enrichment activities!

Quick and efficient!

This manual describes an instructional manipulation that will allow you to teach particular skills, selected from your current curriculum, and get other skills at a "reduced price." It describes how to use a procedure that increases opportunities for learning through the addition of extra information in your instructional exchanges with students. The procedure is easy to implement, relatively quick to deliver, and, in short, is an efficient way to teach additional information. This procedure involves presenting this extra information in the events that follow student responding. It is called "instructive feedback."

Simply stated, the teacher presents a task for the student to learn, and then, after a response, the teacher delivers praise and adds information that is related to the answer. For example, Mrs.

Piper wants John to learn to read vocabulary words from the basal reader. She uses a direct instruction procedure and reinforces him with verbal praise after each correct trial. A trial would sound like this:

Mrs. P.: "John, look. What's this word?"
John: "Lute."
Mrs. P.: "Good."

With instructive feedback (extra learning in the consequence - after the trial), Mrs. Piper modifies her response only slightly:

Mrs. P.: "John, look. What's this word?"
John: "Lute."
Mrs. P.: "Good. It's a stringed instrument."

Therefore, with some planning, but minimal investment of instructional time, the teacher has taught two concepts, sight word reading and definitions, rather than one. John is not expected to respond to the definition, nor is he reinforced for learning the definition but a growing body of literature shows that students of many ages can learn extra information if teachers consistently plan for and add that information after the learning trial.

Why Should We Be Efficient?

More efficient teaching allows students to learn more in the same amount of time or an equal amount in less time, thus freeing time to learn additional skills, spend more time interacting with peers, or refining other skills. Efficient instructional strategies also are those that require less staff instructional time, require less preparation time and less material development, and those that are easier to implement. The rapid learning that students achieve with more efficient strategies often leads to greater teacher satisfaction and more positive interactions between teacher and students (Wolery & Gast, 1990). Instructive feedback meets many of these standards.

What is the Basis for Instructive Feedback?

Instructive feedback is based on three separate but related sources: (a) basic research on incidental learning, (b) research related to using positive reinforcement, and (c) applied research on instructive feedback. **INCIDENTAL LEARNING** refers to students acquiring information that is present in the instructional context but for which there are no programmed contingencies for the learner to acquire that information (Stevenson, 1972). For example, students may be taught a given skill such as how to fry an egg; while learning to do this they learn that the yoke of the egg is yellow and that the clear fluid around the yoke turns white when it is cooked. The teacher is only purposefully teaching the student to fry eggs, and the student learns to do that but also learns other things. Instructive feedback is designed to ensure that children learn those additional things that are related to but are not central to the primary task being taught.

Research on the use of reinforcement has produced many important findings that are incorporated into classrooms throughout the nation. First, this research has shown that the effective use of reinforcement will increase positive behaviors in children and will result in more rapid learning. Second, this research has shown that when delivering reinforcement in the form of praise, the praise should label the behavior being reinforced. For example, we know that praising students by saying "Good, you are reading your book." is better than simply saying "Good." The former tells the student what is "good" about their behavior.

It is extra learning.

Recently, a number of studies have attempted to answer the question, "Can we add extra information into instructional trials and will students learn that extra information?" This research indicates that extra information can be inserted in two places in an instructional trial:

(a) Extra information can be presented immediately prior to an instructional trial (antecedent event); or

(b) Extra information can be presented immediately following a student's response (consequent event).

The purpose of this manual is to describe the second arrangement - the addition of extra information in the praise or feedback events for students. This is called "instructive feedback" because the feedback instructs the student to learn additional information. A companion manual, titled: Increasing Opportunities for Learning through the Addition of Extra Information: Antecedent Events deals with the former.

Research on Incidental Learning and Instructive Feedback

Psychological research studies on incidental learning generally expose the learner to some form of interaction with or attention to the stimuli, and then test for retention. The subjects are not told that they will be tested for recall or recognition, nor they are told to manipulate or focus on one dimension of the stimulus, and that they will be tested on another dimension (Elliot & Carroll, 1982; Stevenson, 1972). Many of the studies test the immediate recall of a word or the information studied. The consensus of the studies is that, although intentional learning is greater than incidental learning, the subjects do recall some of the extra information. As educators and teachers, we are interested in facilitating more than the immediate recall. There is a body of research, using direct instructional models, that goes another step and adds related extra material to an instructional session. One difference between these studies and the psychological literature is that we want the students to learn both the target and extra information, but we reward them for responding to the target information only. Sometimes we test for recall of the extra information after students have acquired the target material and sometimes we test for it during the instructional process.

Is it really incidental?

There is some question about whether information presented in instructive feedback is really incidental learning. In the strict sense it probably is not. Incidental learning studies are designed to understand what students learn when they are not aware that they are "supposed" to learn that information. In instructive feedback studies, the goal is somewhat different. These studies are designed to understand how to allow students to learn more information than they would learn in usual instruction. In these studies, students often are assessed for learning the extra information and then are taught and tested again. This repeated testing may cause students to be aware that they should learn the extra information, and if this occurs, then it is not true incidental learning. However, since the goal is to increase the amount of learning, the fact that it is not true incidental learning is less important.

No responses are required.

A fair question, however, is how is instructive feedback different from direct instruction? At least two differences exist. First, the student does not respond directly to the extra information that is presented in the instructive feedback. In direct instruction, students respond directly to the stimuli being taught. Second, no reinforcement is provided for learning the extra information that is presented in the instructive feedback.

Negligible extra time.

In direct instruction, reinforcement is usually provided for correct responding. The advantages of instructive feedback are that it takes negligible extra time during instruction, and it often leads to extra learning. It should be noted, however, that the research on instructive feedback has always occurred in the context of the direct instruction. That is, students are being taught some skills directly and information about those skills are added to the feedback students receive for learning those directly taught skills.

Section II

Teaching model for increasing learning through extra information in the consequent event

In the literature, direct instructional techniques with the addition of extra information has been used with students of all ages from preschool (age 3-6) to adults. Students with a wide range of handicapping conditions have learned effectively and efficiently with these techniques. Of 87 students taught in 18 studies using direct instruction with extra instructive feedback, only 4 have not reached the criterion set by the instructor for the target behavior and only 4 have not learned some of the extra information. Although this indicates that there are a few for whom the technique is not optimal, most students do benefit from it.

As in any teaching situation, the instructor must make several decisions before beginning to teach. These decisions include what should be taught, when it should be taught, the format (e.g., individual or small group instruction, etc.), and what instructional methods to use to teach it. The factors that influence these decisions and guidelines for making these decisions are beyond the scope of this text. However, several sources exist; for determining what to teach, see Browder (1987), Bailey and Wolery (1989), Snell (1987), Berdine and Meyer (1987), and Taylor (1989). For determining when and how instruction should be implemented, consult Bailey and Wolery (in press); Collins, Gast, Ault, and Wolery (1991); Mercer and Mercer (1989); Snell (1987); Wolery, Ault, and Doyle (in press); Wolery, Bailey, and Sugai (1988). For selecting instructional strategies, see Wolery, Ault, and Doyle (in press) and Wolery, Doyle, Alig, Ault, Gast, and Morris (1988).

For direct instructional techniques with instructive feedback, the teacher must decide on methods for monitoring, when and how the extra information should be delivered, how many pieces of information should be presented, what types of information and what curricula areas may be covered in both target and incidental behaviors. These decisions are summarized in Table 1 and discussed in the following paragraphs.

Table 1

Decisions to be Made Prior to Implementing the Technique

Decision	Example
1. Identify the behaviors the student needs to learn, select a direct instructional technique, and select the time and the format for teaching.	Three students need instruction reading basal reader vocabulary. Constant time delay procedures have been effective for these students in the past; therefore it will be used and instruction will be provided in a small group format.
2. Select the extra information.	These students would benefit from knowing the definitions of these words as well as how to read them.
3. Determine how the target stimuli will be presented. a. What mode of presentation? b. How much or how many?	The teacher chooses to present the words on flash cards. The teacher selects nine words for each student to be taught 3 words at a time to each student. She also selects a criterion of 2 sessions at 100% correct responding.
4. Determine how and when the extra material will be presented. a. What mode of presentation? b. How much or how many?	The definitions are given verbally following correct responses and praise. One definition will be stated each time the child reads a word correctly.
5. Determine how the students are expected to respond to the target material.	The students read the vocabulary words orally.
6. Even though students are not reinforced for learning extra information, determine what responses are expected or allowed.	The students are expected to listen to the definitions but they will not be discouraged from repeating them aloud.
7. Determine how learning of the target behaviors will be monitored.	The teacher will collect data during instruction and daily graphs of percentages of correct responding will be constructed.
8. Determine how extra information will be monitored.	Probes at the conclusion of training will determine the amount of extra information that has been learned.
9. Decide how to adjust instruction if students do not learn.	Evaluations of student performance will be used to make modifications in instruction.

The nine steps, presented in Table 1, are described more fully in the following section. We have included a discussion of some of the research that impacts on each decision so that you may make informed decisions about your students. A summary of the research studies dealing with incidental learning in the consequent event is given in the last section of this manual.

Step 1 *Identify the behaviors that the student needs to learn, select an instructional technique, and select a time and format for teaching.*

Teachers should select material that is developmentally appropriate, that students need to function more competently in the current and future environments, and that is consistent with the student's IEP goals or the curriculum standards of their school district. Ideally, the materials should be interesting and motivating to the child.

Tasks that we teach to students can be broken down into two categories. These are discrete tasks and chained tasks. Discrete tasks, those that require a relatively short answer (one word to a sentence), are particularly appropriate for instructive feedback. These include some language arts material such as sight words, definitions, and spelling, math questions (multiplication facts, coin combinations, shape names), social studies (facts about service agencies), and preacademic skills (colors, letter naming, and numeral recognition). Chained tasks are those that involve a number of responses that are joined together to form a complex skill. These include making a bed, setting a table, and working a long division problem. Chained tasks are outside the realm of this manual because instructive feedback has not been systematically studied and shown to be an efficient technique with the multi-stepped tasks, although it may work with chained tasks as well as discrete ones.

Careful assessment of prerequisite skills prior to instruction can ensure that the techniques and materials are appropriate and therefore that students will learn. In general terms, students must have adequate sensory systems and developmental levels for the methods and materials selected. In addition, they must be able to comply with the requirements of the techniques, (e.g., waiting for the prompt in time delay procedures, discriminating among prompts for SLP, able to clearly indicate a response, etc.)

A number of different instructional strategies can be used in direct instruction (Wolery, Ault, & Doyle, in press; Wolery, Bailey, & Sugai, 1988); examples of these with a short description are shown in Table 2. In fact, a large research base exists for many of those strategies. A couple important findings about these strategies deserve mention. First, many of them can be used with students of different ages. Second, many of them can be used for a number of different types of skills. Third, most of them require careful student monitoring to ensure that students are learning effectively. Thus, in making selections among these strategies, you must be aware of how they are implemented and how they can be adjusted when students do not readily learn.

Table 2

Description of Direct Teaching Strategies

Error Correction - The teacher provides the target stimulus (discriminative stimulus) and presents an opportunity for the child to respond. Correct responses are differentially reinforced, and errors result in a prompt.

Antecedent Prompt and Test - The teacher presents a prompt simultaneously with the target stimulus before the learner responds, presents an opportunity to respond, and reinforces correct responses. In subsequent trials, the prompt is removed and a "test" is given to determine if the behavior occurs when presented with the target stimulus alone. During test trials, error responses may or may not receive a prompt.

Antecedent Prompt and Fade - The teacher presents a prompt simultaneously with the target stimulus, presents an opportunity to respond, and reinforces correct responses. Over trials, the prompt is systematically faded until the learner responds to the target stimulus alone. Fading may occur on the dimensions of frequency and intensity.

Simultaneous Prompting - The teacher provides a prompt simultaneously with the target stimulus, presents an opportunity to respond, and reinforces correct responses. In daily probe trials, the target stimulus is presented alone.

Most-to-Least Prompting (Decreasing Assistance) - The teacher uses a hierarchy of prompts ordered from most to least intrusive. Initially the most intrusive prompt is presented simultaneously with the target stimulus, and correct responses are reinforced. This continues until the child attains a specified criterion level of performance. When criterion is reached with the most intrusive prompt, the next less intrusive prompt is provided until performance meets criterion. This process continues until the child responds to the target stimulus alone.

System of Least Prompts (Increasing Assistance) - The teacher uses a hierarchy of prompts ordered from least to most intrusive. On each trial, the teacher presents the target stimulus alone, and provides an opportunity for a response. If no response or an error results, the least intrusive prompt is presented as is an opportunity to respond. Again, if no response is forthcoming or an error occurs, the next most intrusive prompt is presented with an opportunity to respond. This continues until the child responds correctly. Reinforcement is provided, and the trial is terminated when the child responds correctly to any level of the hierarchy.

Table Continues

Table 2: Description of Direct Teaching Strategies (continued)

Constant Time Delay - The teacher initially presents the target stimulus simultaneously with a controlling prompt followed by an opportunity to respond for a specified number of trials. Correct responses are reinforced. For subsequent trials, the interval between the delivery of the target stimulus and presentation of the prompt is increased for a fixed number of seconds. Correct responses before and after the prompt are usually reinforced.

Progressive Time Delay - The teacher initially presents the target stimulus simultaneously with a controlling prompt followed by an opportunity to respond for a specified number of trials. Correct responses are reinforced. For subsequent trials, the interval between the delivery of the target stimulus and presentation of the prompt is gradually increased. Correct responses before and after the prompt are usually reinforced.

Graduated Guidance - The teacher begins each trial with the type and amount of prompt necessary, and as the child begins to perform the task the prompts are removed immediately. If the child stops or begins to perform incorrectly, the type and amount of prompts needed are immediately applied and withdrawn as appropriate. Reinforcement is provided if the child completes even a minimal amount of the task correctly; reinforcement is not provided if the child resists at the end of the task.

Incidental Teaching - The teacher arranges the environment to cause the child to initiate. When the child initiates, the teacher asks for an elaboration of the child's language and provides a response interval. If the elaboration is forthcoming, the teacher responds according to the child's initiation (e.g., supplies permission or information). If the elaboration is not forthcoming, the teacher provides a prompt and another response interval and provides consequences as described here.

Mand-Model Procedure - The teacher observes the child and notes his/her focus of attention. When the focus of attention is determined, the teacher provides a mand (non yes/no question) and provides a short response interval. If the child responds correctly, the teacher praises the child and terminates the interaction. If the child does not respond correctly, the teacher provides a model, a response interval, and consequences as appropriate.

Source: Bailey, D. B., & Wolery, M. (in press). Teaching infants and preschoolers with disabilities. Columbus, OH: MacMillan.

In addition to the instructional strategy, you must consider the instructional format. Many students with handicaps are taught in one to one situations but this may not be the most effective method. Group instruction may be effective in freeing instructional time, facilitating social interactions and in providing opportunities to learn from other students. Collins, Gast, Ault, and Wolery (1991) list several decisions that are important to consider when designing small group instruction for students. The size of the group is determined, in part, by the students' experience with group settings, the presence of appropriate group skills, the type of task to be taught, and session length. Heterogenous or homogeneous groupings can be used. The students may be taught the same tasks or they may all be learning different tasks, giving them an opportunity to learn from observation of other students' tasks. Student characteristics, classroom configurations and the nature of the material to be taught will help determine the format chosen.

The time for instruction is another variable to be planned. Many of the studies conducted one session per day with the time selected dependent on the classroom schedule. Others worked in two a day, typically one in the morning and one in the afternoon. One study (Wolery, Werts, Holcombe, Billings, & Vassilaros, 1991) taught dispersed trials throughout the day during transitions from one activity to another. Your situation will determine what will provide the greatest opportunities for learning for each of your students.

TASK 1:

Identify for your situation, a student or students to whom you want to teach target and extra information. As you read through the manual, continue to use these students as you work through the steps for implementing this model.

a. Student(s) ______________________________

____

b. Target skill: ____________________________

c. Instructional strategy: ____________________

____

d. Number of students to be taught: __________

e. Time of day for instruction: ______________

____

f. Number of sessions per day/week: __________

____

Step 2 *Select the extra information to be presented.*

Not surprisingly, the selection of the extra material should be undertaken with as much care as the selection of the target behaviors. Primarily, the extra material has been related in some way to the targeted behaviors (i.e., sight words and their spellings, vocabulary words and their definitions, photos and labels or words, coins and their values, etc.).

Spelling and definitions were taught to augment sight words (Gast, Wolery, Morris, Doyle, & Meyer, 1990; Gast, Ault, Wolery, Doyle, & Baklarz, 1990). Modelling and signing have been taught to augment receptive identification of objects and pictures (Gast, Doyle, Wolery, Ault & Farmer, 1991). Additional facts were added to one base of facts that were targeted (Wolery, Alig-Cybriwsky, Gast, & Boyle-Gast, 1991; Doyle, Gast, Wolery, Ault, & Farmer, 1990). In some cases, the incidental material has been an extension of the target. Werts, Wolery, Holcombe, Vassilaros, and Billings (1991) taught shape names and added the color name of the shape. Harrell, Wolery, Ault, Demers, and Smith (1991) taught antonyms and used the sight word and the definition of the opposite as the incidental. Edwards (1989) taught students to spell abbreviations and then tested to see if they could spell the whole word used as a stimulus. These studies required that the students relate the target stimuli to the incidental.

However, other variables also must be considered. Of course, the material must be developmentally appropriate. In one study, (Wolery, Werts, Holcombe, Billings, & Vassilaros, 1991), students were taught two pieces of information following instruction on recognizing an array of pennies. They were shown the numeral that corresponded to the value of the array and the written number word in two presentation formats. One 4-year-old student learned the numerals that corresponded to the values of the pennies but only half of the written number words. It was postulated that the "easier" task, that of reading numerals, was appropriate, whereas, reading number words was not yet appropriate for her. Wise (1990) taught complex multi-syllable words to adolescents and added definitions as the consequence. The students learned the words rapidly but showed a low rate of learning the definitions. Again, the author concluded that the wording of the definitions were difficult and that the students may not have known what the definitions meant. Gast, Wolery, Morris, Doyle, and Meyer (1990) found learning of extra behavior presented in instructive feedback to be at a low rate and noted, "low percentages of correct responding ... may relate to the difficulty of the target task." (p. 20)

Interest level may also be a factor. Some material is more interesting to some students than to others. For example, science facts may be of great interest or of no interest at all. Motivation may also play a part. This, in many cases, may be taken care of by the manipulations of the reinforcement schedules, but the concerned professional will look to the involvement level of the students as the teaching is progressing.

The following table lists information, both target and extra, that has been taught in research studies using instructive feedback. In addition, below the dotted line, there is a listing of skills that may be considered for use with this technique. Other skills can be added to the list as you consider your students and their needs.

Table 3

Target Behavior and Related Extra Information

Target	Extra Information
Sight words	Definitions
Sight words	Spelling
Sight words	Manual signs/pictures
Recipe words	Demonstration of the action Use of the object
Spelling abbreviations	Spelling the referent word
Social studies facts	Related facts
Rebus symbols	Classification of the objects
Shapes	Colors
Antonyms	Sight words/definitions
Coins	Number words/equal values of pennies numerals
Numerals	Number words
Labels for photos	Sight words for the labels

……

Addition facts	Answer plus one more
Adding fractions	Decimal or percentage equivalents
Geometric shapes	Degrees in the angles
Foreign language vocabulary	Definitions/spelling
Foreign language vocabulary	Use in a sentence
Grammatical construct	Examples of nouns, verbs, etc.
Spelling	Rules of spelling
Battles of the Civil War	Generals, locations, victors, etc.
First lines of poems	Authors

TASK 2:

Select the extra skills or materials to augment the target concepts you will teach to your students. ____

____

____

Step 3 Determine how the target stimuli will be presented.

This decision must be based on the characteristics of the skills, the technique used, and the learner. For the discrete tasks that are addressed in this manual, material has been presented verbally, signed manually, printed on flash cards, flashed on a computer screen, and depicted in photographs or line drawings. Thus, a variety of means for presenting target stimuli have been evaluated.

In direct instructional techniques, the instructor must also decide how the trials are to be distributed throughout the day. They may be presented in a massed-trial format, in a spaced trial format, and in distributed trials throughout the day (Mulligan, Guess, Holvoet, & Brown, 1980). Massed trials refers to the presentation of trials so that other behaviors do not occur between them. Repeated drill with flash cards would be a massed trial format. Spaced trials require a pause or a rest period (e.g., 15 seconds) between each trial. Distributed trials occur throughout a time period (sometimes as much as the whole school day) and have other related or non-related tasks presented in between the trials (e.g., transition-based teaching).

Another critical decision is how many items should be taught at one session. In the literature, up to 5 items have been taught per condition. Younger children have typically been given fewer items, with two being the most common number taught. Doyle, Wolery, Ault, Gast, Wiley

(1989) compared teaching two behaviors concurrently to teaching one behavior at a time. They found that students learned to discriminate between two items more efficiently if two were presented at once. They concluded that the students learned to look at salient variables of the stimuli allowing the discrimination between the two concurrent stimuli to be rapidly learned.

The number of trials per session for the entire group depends on the number of items you have chosen to teach each student, the number of students in the group, the age and functioning levels of the students. Since students respond to each trial, the session length will increase as the number of trials increases. In the literature, the number of trials in a session varies from 1 at a time for transition based teaching (Werts et al., 1991) to 64 (4 students learning 4 facts each with 4 repetitions of each fact) (Wolery, Cybriwski, Gast, & Boyle-Gast, 1991). Typically, the students saw each stimulus 2 to 4 times in a session, with the stimuli being shown no more than twice in a row. For groups of students, the stimuli can be presented in a predictable manner or an unpredictable manner. If the teacher always presents stimuli from left to right, students may be able to predict when their turns will come. A randomized manner (e.g. no more than two turns for any student, no consistent order of calling on students, etc.), may facilitate attention from students (Collins et al. 1991).

TASK 3:

Identify how the target material is to be presented.

a. What mode of presentation? ____________

____

b. How are the tasks to be distributed? __

____

c. How many stimuli are to be taught? ___

d. How many times will you present each stimuli? ______________________________

Step 4 Determine how and when the extra material will be presented.

The incidental material has been shown on flash cards with no verbal cues or reinforcement. It has been shown on flash cards with verbal reading of the card by the teacher. One study showed the word that the student was learning to read and the teacher recited each letter of the word aloud. Information has been signed as well as said. Words have been shown on a computer screen and spoken by a speech synthesizer. In one study, the students were allowed to imitate the modeled action of an object if they desired. However, most of the extra information has been presented verbally. Obviously, decisions regarding method of presentation must consider student characteristics as well as characteristics of the stimuli. Student's acuities and sensory abilities are critical. For example manual signing or total communication may be most appropriate with students who have hearing impairments. Students with visual impairments may need tactile stimuli or cards with large bold type. Material and information also dictate some decisions regarding presentation. Identification of colors require a visual presentation. Identification of coins may be visual or possibly tactile. Facts, word recognition, or numbers could be presented verbally or with a combination of modalities. These decisions need to be considered carefully for each situation.

Several studies have presented the information on every trial where the student responded correctly. Others have interspersed the incidental trials with those looking at other variables. Although we cannot directly compare the amount of learning, it is instructive to see that incidental information does not seem to interfere with learning target material. Janssen and Guess (1978) found that modelling the function of an object after correct pointing to the correct object allowed severely retarded individuals to acquire labeling skills faster than the training alone.

Several studies have extended the addition of information to look at the amount of material that may be added. Wolery, Werts, Holcombe, Billings, and Vassilaros (1991) added two types of information for each target behavior: one condition information for each target behavior: one condition added two types simultaneously (two pieces of information on one flash card after every trial) and one condition added two types but presented each one every other trial. There was no substantial difference in the amount of information learned between the two presentation methods. One student in that study learned all of "easier" information and very little of "harder" task. Harrell et al. (1991) directly taught antonyms and added the sight word and a definition as the consequent event. The students learned to read the words at high percentages (over 80% correct responding) and 3 of the 7 students also learned to respond correctly with the definitions of the words (two of them at 100% correct responding). The number or amount of extra information learned may be a function of the difficulty of the material instead of whether one or two pieces are presented. The research literature does not indicate whether more than two pieces or types of extra information can be learned.

The method of presentation includes more than the number of items presented per trial. Extra information has been inserted into praise statements, and in both praise and correction statements. Systematic comparison of the two techniques has not been conducted but in looking at the research it would appear that a greater number of errors occur with the addition of information in both praise and correction statements. The students do get greater exposure to the material but it has not been shown that this leads to greater learning. Keel and Gast (in press) used feedback in both praise and correction statements but their students evidenced near errorless learning so few opportunities for presenting extra information after errors occurred. Wolery, Werts, Holcombe, Billings, and Vassilaros (1991) and Werts, Wolery, Holcombe, Vassilaros, and Billings (1991) provided extra information for correct and error responses in feedback events. The error rates were higher, and although not directly comparable, the learning rates for extra information were lower than other studies. This may have been due to many other procedural modifications and the characteristics and ages of the learners but it is a variable worth considering.

It improves with age.

One interesting by-product of the research is that students seem to become more efficient with increased experience with the technique. It has been noted, but never systematically investigated, that the number of trials to criterion decrease in successive tiers and the number of errors tend to decrease. Wise (1990) taught four students to state definitions to supplement sight words. After the first tier of training, only one student responded to the incidental probes correctly. On the second and third tiers, all four students responded correctly to some of the definitions (between 20 and 60 percent). The overall responding was low (mean was 18.3% but this was depressed due to the non-responding in the first tier.) The technique seems to "improve with age." It is as yet unclear just when, if ever, this phenomenon levels out.

TASK 4:

Determine how and when the extra material is to be presented.

a. What mode of presentation is appropriate?

____

b. How often is the information to be added?

____

c. How many pieces of information are you adding to each trial?____________________

____

d. Are you adding the extra information after correct responses only or after correct and incorrect responses?____________________

____

Step 5 Determine how the students are expected to respond to the target material.

The response of the student must be clear enough to be judged as correct or incorrect so that a reinforcer can be delivered. Obviously, the modes of communication of the students must be taken into account. The child who is non-verbal may be asked to point, sign, indicate a response on a communication board or a computer. Language appropriate to the student's abilities should be accepted.

TASK 5:

Identify the appropriate response to the target material.

____

____

____

Step 6 Although the students are not reinforced for learning extra information, determine what responses are expected or allowed.

Basically, in the research, the students have not been required to make any response to the extra information during instruction, nor have they been rewarded for responding to it. Sometimes the students do respond. In the study by Wolery, Werts, Holcombe, Billings, and Vassilaros (1991), the students were shown a card with information on it after they responded with a number answer. A word and pennies were on the card and the investigator said, "And that's (five), too.' The students frequently imitated, "and that's (five), too." It is unclear how it may have affected the learning of the extra information. In this study, the students modelled the information correctly. There is a question then as to what should have been done if they had not been correct. Incorrect responding might have been extinguished with further trials or the students might have benefitted from a correction model.

TASK 6:

Decide how to react (or not react) to spontaneous responses to incidental information:

a. ignore

b. correct if responded to incorrectly

Step 7 Determine how learning of the target behaviors will be monitored.

Step 8 Determine how extra information will be monitored.

Monitoring is a basic component of the high quality instruction. It is helpful to know when the students have learned the material. A number of different data collection systems exist for monitoring learning (Wolery, Ault, & Doyle, in press; Wolery, Bailey, & Sugai, 1988). The method used may vary depending on the instructional strategy used.

What is not clear is whether the monitoring system chosen and the amount of monitoring assists in boosting learning of the incidental material. Wolery, Fleming, Venn, Domjancic, and Thornton (1991) used a direct instructional strategy in a group and found that students who were not monitored learned less of the target material than those who were probed daily to assess learning rates. Later, the students who had not been in daily probe sessions initially were placed in further group training and probed daily and their acquisition of skills reached the criterion level very quickly.

Most direct instruction techniques include methods for monitoring. Probing to determine the levels of incidental learning that is occurring can be implemented on a daily basis or after students achieve criterion on target skills. Some instructional strategies include daily monitoring to determine when to move to the next level of prompts, or to the next level of information, etc. Some techniques, such as simultaneous prompting or transition-based teaching, may require a separate session to measure daily progress. You will need to examine the techniques you have selected to determine whether the data collection methods give enough information or whether you need to add daily probes.

TASKS 7 and 8

Identify the monitoring techniques used by the strategy you have selected.______________________

____

____

Identify the monitoring techniques that you will use to assess the amount of extra learning that is taking place.

Are daily probes needed as well? ____________

____

If so, what form do they need to take? ______

____

____

Step 9 *Decide how to adjust instruction if students do not learn.*

We know that monitoring acquisition rates allows us to systematically evaluate how the instruction is proceeding and to modify procedures to allow students to learn more effectively. These instructional techniques are not static and when a student is having difficulty with a task, several modifications have proven helpful. Sometimes a very simple change in reinforcers or the reinforcement schedule will produce greater achievement. Although we carefully assess what is reinforcing for each student before we begin direct instruction, the strength of reinforcers change with the passage of time and use. Using a more frequent schedule of reinforcement or changing to a primary reinforcer may accelerate learning. Generally, in the time delay literature, students have been rewarded for both correct responses before and after the prompt. This generally leads to near errorless learning. Some students, however, will develop a strategy of waiting for the prompt to receive the reward without learning to answer correctly. This can be "cured" by rewarding only correct answers before the prompt (differential reinforcement). It is not desirable to implement this technique from the start because the error percentage may be higher and the learning rates are slower but it is a modification that is needed with some students.

Attending cues speed learning.

Specific attending cues have been added when the instructor sees errors or patterns of learning that indicate that the student is not focusing on relevant variables of the stimuli. In trials involving learning to read sight words, students have been asked to listen to the spelling of the words, to match words, to recite each letter aloud, or to write the word. Each acted as a cue to pay attention to all the letters of the word. Other methods of ensuring maximal attention to the target stimuli have included matching the stimuli to a sample--usually a two to four choice format, touching or tracing the stimulus, and repeating the question either individually or chorally during group instruction.

TASK 9:

Be prepared to evaluate each student as the training progresses for patterns of learning that indicate a need for a modification.

SECTION III

The Model in Practice

The following examples will illustrate the process of devising instruction using instructive feedback and the decision model outlined above.

Small group

Mrs. Lee taught in an integrated sixth grade classroom in a public school. She had several students who needed to "catch up" with the class in addition of fractions. On a unit test following the chapter, four students scored less than 50% and analysis of errors indicated that they did not understand that they were to add the numerators for fractions with like denominators. Jeff, Sean, Michelle, and Stephanie were familiar with time delay procedures. Since constant time delay has been shown to be somewhat more efficient than progressive time delay and because it is easier to implement, Mrs. Lee decided to teach addition of fractions with like denominators using a group constant time delay procedure. To simplify the procedure, she taught the same fraction combinations to each member of the group. She prepared flash cards with the problems written on them, choosing 3 target problems for the first set. Each student would be asked to respond twice to each problem, giving a session of 24 trials (3 problems x 2 presentation to each student x 4 students). Each session would typically take 7 or 8 minutes.

Choose the extra material.

The rest of the class had learned percentage equivalents for some fractions as well, and each of these students showed some weaknesses in this area. Mrs. Lee chose to make her procedure more efficient by adding percentage equivalents as a consequence. There is a one to one correspondence to fractions and the corresponding percentage and so Mrs. Lee further decided to add only one piece of information as incidental information. She would present it both verbally and visually with the percentages written on the back of the flash cards she had prepared for the problems. She would present the incidental information only after correct responding by the students to keep the error rates as low as possible. The students would not be expected to respond to the information and Mrs. Lee anticipated that it would add only a few seconds to each trial.

The training sessions followed the procedures for constant time delay. For each correct answer, Mrs. Lee added the incidental information. For example, she would say, "Good...and this is equal to 3/4." At this point she would show the back of the flash card that had "75%" written on it.

Monitoring is important.

Monitoring was ongoing while the sessions were taking place. Mrs. Lee taught the sessions immediately after she presented a math lesson when her classroom routine called for her students to start independent math practice. She recorded the number of times each student correctly waited for the prompt and the number of correct answers given before the prompt. Graphs were kept of each student's performance. Michelle, Jeff, and Sean learned to respond correctly to the problems that Mrs. Lee presented. Stephanie consistently added both the denominators and the numerators of the fractions. Mrs. Lee instituted an attentional cue for her. She presented the stimulus card to Stephanie and said, "Touch the numerators." When Stephanie had done so, she continued with the trial by asking her to respond with the correct answer to the problem. Stephanie began giving correct anticipations before the controlling prompts.

The group's criterion level of responding was set at three days at 100% correct responding. When all four students reached this level, Mrs. Lee tested them again on the skill of adding fractions. Michelle and Sean were able to transfer the training they had received to other behaviors. Stephanie and Jeff were able to add some fractions they had been trained on, but made some mistakes when they added then in a pencil and paper format. Mrs. Lee prepared another set of problems for further training for Stephanie and Jeff. She also tested the acquisition of percentage equivalents for all four students and found that their overall responding to the trained equivalents was at 85%, roughly the same as the rest of the class.

Mrs. Lee could have made other choices about her procedures which may have made the procedure even more efficient. She could have taught different problems to each student so that they had the benefit of learning from hearing the other students' answers. She could have added two pieces of information after each correct answer. For example, she might have written each card to read "75% = .75" and taught percentages and decimals. Individual sessions or having individuals exit the group as they reach criterion may have been more efficient for some students.

Transition-Based Teaching

Minimal time investment.

Other instructional techniques can be augmented with incidental information to make instruction more efficient. Karen taught a class of nine preschoolers identified as speech and language impaired and or hearing impaired. She wanted to teach color names to the children. Observation and diagnostic teaching showed her that the children could not all name the basic shapes and that there were shapes that none of the children could name. Since she wanted to maximize the efficiency of her teaching and add this dimension to an already full curriculum, she decided to use transition-based teaching with a constant time delay. Since there were two dimensions of the behaviors she wished to teach, she further decided to use incidental learning to add the names of the shapes to the color trials. To make the procedure consistent, she chose to add the incidental information to both the praise and the correction statements rather than adding it to praise statements and ignoring errors.

Karen tested each child in the class to find a baseline for the ability to expressively name the colors that she wanted them to learn. Seven of the students could not name any of them. Christopher named purple consistently and Megan sometimes named purple and blue correctly but she sometimes confused them. Karen then tested to see if each student could name the shapes and she identified 6 shapes that none of the students could identify but that she wanted them to know. The next step in the assessment was to ensure that the children had the visual acuity to attend to flash cards, and that they could match each target color and shape to a sample seen in a three choice format. This ensured that they could visually discriminate between the shapes and colors well enough to learn the different names. Karen also tested to assure herself that they were verbally or manually dexterous enough to indicate the names of the colors and shapes.

She chose 6 colors and 6 shapes to be taught and prepared white 5x8 index cards with a colored shape on each card. She also prepared cards with black ink line drawings of the shapes on them. and cards that were colored to match each of the colored shapes.

On the first day of training, Karen followed the classroom's usual routine until circle time was over. The procedures in the class called for her to direct each child individually to an activity area. She called each child by name but instead of immediately sending them to the table, she held one card and asked, "What color is this?" Following the procedure for 0-second trials for CTD, she immediately said, "It's purple." The student modelled, "It's purple." Karen added, "and its a triangle." Then she called the next student. Jason listened while she asked, "What color is this" and he did not respond but turned toward the activity table. She directed his attention to the card again and said, "Jason, what color is this? Its purple." Jason responded with "Purple." Karen added the incidental information and Jason was allowed to proceed to the table. The procedure was repeated with each student. The whole procedure was repeated with the second stimulus during the next transition, from the activity areas to the snack table. The two stimuli were taught three times each that day. Each trial took approximately 5 seconds per child, adding less than a minute to each transition.

Daily probes may help.

The following day, Karen expanded the delay between the question and the controlling prompt from 0 seconds to 3 seconds. She also started daily probes to determine individual learning. Although she had decided on a group criterion for changing target stimuli, she wanted individual data for IEP information. The probes took approximately 45 seconds per child. She gave each child 4 trials per probe (two per stimuli) once a day.. These were conducted during nap time, following activities, and while waiting for the bus to arrive.

Karen's students learned the first two color names within seven days of training which Karen calculated as approximately 30 minutes of her class time. They were responding to colors of objects in the classroom with approximately at 75% rate of success and were improving daily. The incidental learning of shape names was at a lower rate but Karen felt that it was good to have her students respond correctly, at least half the time, on information that they had not been directly taught and that they did not know at all a few days earlier. She knew that she could bolster this skill at a later time.

To summarize, we can increase opportunities for learning by adding incidental information to the targeted information. By inserting incidental material into the feedback statement following each learning trial, extra information is learned "for free." The student is not required to respond to this extra material and is not rewarded for doing so. The addition is "quick and painless," and makes our teaching more efficient.

The decision making questions are presented again so that you may plan instructional sessions for your student(s) that include incidental learning. Using the notes you made in the Task sections, plot the target and incidental information you would like to teach to your students. List the information as it will appear on the cards, or on the computer screen, or that you will say to the students during training. Then list the incidental information that you will use and plan it according to the steps you have learned.

Decisions to be Made Prior to Implementing the Technique

Student(s): ______________________________

1. Identify the behaviors the the student needs to learn, select a direct instructional technique, and select the time and the format for teaching.

2. Select the extra information.

3. Determine how the target stimuli will be presented.
   a. What mode of presentation?
   b. How much or how many?

4. Determine how and when the extra material will be presented.
   a. What mode of presentation?
   b. How much or how many?

5. Determine how the students are expected to respond to the target material.

6. Even though students are not reinforced for learning extra information, determine what responses are expected and allowed.

7. Determine how learning of the target behaviors will be monitored.

8. Determine how extra information will be monitored.

9. Decide how to adjust instruction if students do not learn.

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SECTION IV

Research

This section reviews the relevant research studies that were identified for this technique. They are presented here for reference and so that you may compare the variables that influence your situation with those used in research studies. A complete reference list is supplied in the appendix. The studies are summarized in Table 4.

Eighteen studies were identified that used direct instructional techniques and added incidental information in the consequent event. Seven of these taught sight words either selected from the curriculum materials such as from a basal reader, or selected from the environment of the students. Four of the seven teaching sight words added definitions as the "extra" material (Stinson et al., 1989; Gast, Wolery, Morris, Doyle, & Meyer, 1990; Shelton, Gast, Wolery & Winterling, 1991; Wise, 1990), one added a picture of the action word learned or modelled the action (Gast, Doyle, Wolery, Ault & Farmer, 1991), one added manual signs for the word (Carper, 1990), and one added the spelling of the stimulus word (Gast, Doyle, Wolery, Ault, & Baklarz, 1991a). One study used a computer to teach spelling of abbreviations and added the spelling of the whole word (Edwards, 1989). Two studies taught facts about service agencies and added additional facts as the incidental material (Doyle, Gast, Wolery, Ault & Farmer, 1990; Wolery, Cybriwski, Gast, & Boyle-Gast, 1991). One taught students to recognize rebus symbols and tested to see if they learned to classify the referent objects (Wolery, Holcombe, Werts, & Cipollone, 1991). Three studies added more than one piece of additional information (Harrell, Wolery, Ault, Demers, & Smith, 1991; Gast, Doyle, Wolery, Ault, & Baklarz, 1991b; Wolery, Werts, Holcombe, Billings, & Vassilaros, 1991). One study used transition based trials (Werts, Wolery, Holcombe, Vassilaros, & Billings, 1991). One used simultaneous prompting and added information and then tested to see if toddlers could use the information to classify foods. Two studies expanded the concept of incidental learning to see if exposure to incidental information enhances future learning (Wolery, Doyle, Ault, Gast, Meyer, & Stinson, 1991; Holcombe, Wolery, Werts, & Hrenkevich, 1991.).

Both group and individual instruction was deemed effective. A variety of instructional strategies were used as well. The procedure was used with constant time delay, progressive time delay, simultaneous prompting, transition based teaching, trial and error testing, and computer aided instruction.

The percentage of incidental material learned ranged from 18.3% to 93%. There seemed to be no definitive pattern for the low scores except that it may relate to the difficulty of the material for the students involved. Several authors alluded to this fact. Others mentioned that the stimulus may not have been attended to (Edwards, 1989).

In an early study, Janssen and Guess (1978) taught four adolescent residents of a state institution to label objects and compared a labeling only condition with a labeling and receiving information about the objects function and being allowed to manipulate the object as a consequence to a correct response. Results indicated that the students acquired labeling skills faster with the function added to the training than by the label only method.

Stinson, Gast, Wolery, and Collins (1991) taught sight word reading using progressive time delay with group instruction for four elementary aged students with moderate mental retardation. Definitions were inserted into praise statements following correct identification of the words. The overall means for acquisition of definitions were 78% for target words and 61% for words of the other student in the dyad.

Wise (1990) investigated the use of constant time delay procedures in a group instructional format with four adolescents diagnosed with mild delays. The students were taught complex, multi-syllable vocabulary words and the definitions were inserted in the praise statements. Students responding increased from 0% to 18.3%. The low rate of acquisition of definitions was perhaps due to the rapid rate of learning of the vocabulary words, and to the difficulty of the words in the definitions.

Gast, Wolery, Morris, Doyle and Meyer (1990) taught five elementary aged students with moderate retardation to read environmental sight words and the definitions of the words were inserted into praise statements. All students learned some of the incidental information for both target words and words taught to other group members. Some students learned considerably more than others but the overall mean was 37.8% (range 11.1% to 83.3%).

Carper (1990) used a progressive time delay procedure to teach sight word reading and picture identification to five high school students with moderate to severe retardation. Although all students did not learn all the behaviors to the criterion level, three students completed the training, and one student learned one pair of words. Overall, the five students learned 39.1% of the incidental information (signs and expressive identification of pictures) that was inserted into the praise statements.

Shelton, Gast, Wolery, and Winterling (1991) taught eight students (elementary aged, mild handicaps) to read functional sight words. The authors inserted spelling into the antecedent event and definitions into the consequent event. They also used group instruction and allowed some students to be observers only in some groups. Performance in incidental learning was variable across students but all students learned some incidental information. Percentage of correct responding across students and conditions on definitions was between 25 and 100 percent (mean = 70%) and for spelling it was between 0 and 100 percent (mean = 46%).

Gast, Doyle, Wolery, Ault, and Baklarz (1991a) studied the acquisition of spelling competence when learning to read words. They taught the subjects, four primary aged students with mild mental handicaps, to recognize sight words. The teacher modelled the correct spelling either before or after the student's reading response. They found that the incidence of correct spelling increased more with the antecedent model for the short term but that in the posttest condition, the spelling was greater for words that had been modelled in the consequent event. They theorize that for long term retention, the consequent incidental teaching was the most effective.

Doyle, Gast, Wolery, Ault, and Farmer (1990) compared the amount of learning when students were taught two target and six observational social studies and health facts and when all students were taught the same eight facts. Incidental information was added to all conditions. Students learned slightly fewer facts (mean=15) when taught two targets and 6 observational than when taught all eight facts directly (mean=16) but the technique using observational learning was more efficient in terms of number of sessions and amount of time for instruction. Students acquired incidental facts with slightly higher levels for the target facts but with an overall level of about 75%.

Gast, Doyle, Wolery, Ault, Farmer (1991) compared progressive time delay and the system of least prompts for effectiveness and efficiency and added incidental information to the consequent event to see if it added to the efficiency of the procedures. The investigators taught four high school aged students with moderate to severe delays to read recipe words. Incidental information added to the consequent event included demonstrating the action that was pictured or demonstrating the use of the object shown to the student. They found that both of the descriptive strategies and the system of least prompts alone (which contained incidental information in the prompt hierarchy) were effective in teaching extra information at above 75% correct responding across all students. Some increases were also seen with the progressive time delay alone, possibly due to generalization effects.

Wolery, Holcombe, Werts, and Cipollone (1991) taught toddlers (aged 2 to 3 years) to recognize rebus symbols for foods using a simultaneous prompting procedure and inserting information that classified the symbols after the correct response. The toddlers learned to recognize the symbols and to classify the foods into breakfast and lunch foods or substances to eat and those to drink.

Wolery, Cybriwsky, Gast, and Boyle-Gast (1991) investigated whether specific attentional responses impacted learning of incidental material. They taught social studies and health facts to 4 adolescents with learning or behavior disorders. They used a constant time delay procedure in a small group with two attentional responses and two types of feedback for correct responses. They found that general or specific attentional responses did not affect the acquisition of target facts but that more incidental and observational learning was acquired and maintained with a specific attentional response (asking the student to repeat the question).

Edwards (1989) used computer assisted instruction with a constant time delay paradigm to teach four high school students with mild delays to spell abbreviations of words. All four students did learn to spell the abbreviations with a high degree of efficiency. Incidental learning was defined as being able to spell the referent word. Three of the four students learned to spell some of them but the levels of learning were not high. Net gains between 7 and 34% were reported for the three students with an overall net gain of 18.5%. The computer program included a speech synthesizer so the students did not need to look at the referent word.

Werts, Wolery, Holcombe, Vassilaros, and Billings (1991) taught three preschool-aged students with hearing impairments to name shapes and added the names of colors as incidental information. Using a constant time delay procedure with transition based teaching, and minimal instructional time, they found that all students learned the names of the shapes to the criterion level, all generalized the naming of some shapes to other stimuli, and all learned some of the colors. The incidental learning was at a low level (22.2%; range 0% to 50%) overall on the final probes possibly due to the minimal instructional time (under ten minutes total over four months) and the nature of the probe questions calling for generalizations rather than direct recall of trained stimuli.

Wolery, Werts, Holcombe, Billings, and Vassilaros (1991) taught five preschool aged students with language and hearing impairments to recognize coin combinations and inserted two pieces of information in the praise and correction statements. In one condition, the two pieces were seen simultaneously on every trial. In the other, the students were shown one piece of information on every other trial. Four of the students reached criterion in correct responding on target material and learned some of the incidental material. Learning of the incidental material was again variable across students. The mean correct responding across students for both direct recall of incidental material and stimulus equivalence questions was 63.1%. No difference was found for the method of presentation.

Harrell, Wolery, Ault, Demers, and Smith (1991) taught antonyms to students and added two types on information as a consequence for correct responding. The students saw the written word for the antonym that they learned and heard a verbal definition of the word. The students were later able to read the written word at a high rate, (mean=81.2%). One student was able to state all the definitions, one was able to state the definition of 50% of the words in one of the two sets and the others could not state them.

Gast, Doyle, Wolery, Ault, and Baklarz (1991b) taught students to name photographs of local buildings and places of interest using a constant time delay procedure. They added extra information in the form of addresses and activities that typically occurred in each place. When the students were to learn the address only, all students learned all addresses. When two activities were presented they learned both of these. However, when the activity and the address were presented together, they learned only the activity. The authors postulate that the information that was easier, or of more interest, was the one that the students remembered.

Two studies were initiated in an attempt to find if the incomplete learning of the incidental information would then lead to more rapid complete acquisition of the information. Wolery, Doyle, Ault, Gast, Meyer,and Stinson (1991) added the presentation of the written word for the label of a photograph to the target task of learning to name then. Seven of the eight subjects learned some of the words. In a replication of the study, four students learned to name pictures of fast food restaurants and were shown the written names of the restaurants during the praise statements following the trials. Two of the students learned to read half of the written words and two of them learned to read all four. Future training then showed that the students were able to acquire the information that they had been exposed with fewer trials to criterion than material they had not seen. Holcombe, Wolery, Werts, and Hrenkevich (1991) taught numeral recognition to preschool-aged students with mild delays. The students were shown the written word for the numeral following correct responses but were given no verbal cues. The students learned to recognize some of the written words. In further training, they acquired the skill of reading the number words they had seen more rapidly than other number words they had not been exposed to.

Table 2

Studies that incorporate incidental learning in the consequent event

Target	Incidental	Presentation	Mean % Acquis	Strategy	Age	Diagnosis	Reference
Sight word	definitions	verbal	78	PTD-group	elementary	moderate mental handicap	Stinson, Gast, Wolery, & Collins (1991)
Sight word	definitions	verbal	18.3	CTD-group	secondary	mild mental handicap	Wise (1990)
Sight word	definitions	verbal	70	PTD-group	elementary	mild	Shelton, Gast, Wolery, & Winterling (1990)
Sight word	definitions	verbal	37.8	CTD-group	elementary	moderate mental handicap	Gast, Wolery, Morris, Doyle, & Meyer (1990)
Sight word/ picture id	signs/picture picture card	modelled	39.1	PTD-group	secondary	severe mental handicap	Carper (1990)
Sight Word	spelling	verbal flash card	87.5	CTD-group	elementary	mild	Gast, Doyle, Wolery, Ault, & Baklarz (1991a)
Sight word (recipe)	demonstration picture	modelled picture card	75	PTD of SLP	secondary	moderate-severe	Gast, Doyle, Wolery, Ault, & Farmer (1991)
Spelling abbreviation	spelling referent word	computer screen	18.5	CTD-CAI	secondary	mild	Edwards (1989)
Labeling	modelling the function	modelled	NA	trial/error	secondary	profound mental handicap	Janssen & Guess (1978)
Social studies	additional facts	verbal	75	CTD-group	secondary	moderate mental handicap	Doyle, Gast, Wolery, Ault, & Farmer (1990)
Social Studies	additional facts	verbal	71-93	CTD-group	secondary	learning/behavior disordered	Wolery, Cybriwsky, Gast, & Boyle-Gast (1991)
Photos of buildings	A. addresses B. activities	verbal	A. 0-100 B. 100	CTD-group	elementary	moderate mental handicap	Gast, Doyle, Wolery, Ault, & Baklarz (1991b)

Table continues

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Table 2 (continued)

Target	Incidental	Presentation	Mean % Acquis	Strategy	Age	Diagnosis	Reference
Rebus symbols	classification	verbal	79	CTD-group	toddler	mild	Wolery, Holcombe, Werts, & Cipolloni (1991)
Shapes	colors	verbal/sign flash card	22.2	CTD-TBT individual	preschool	hearing impaired	Werts, Wolery, Holcombe, Vassilaros, & Billings (1991)
Antonyms	A. word B. definition	flash card verbal	A. 81 B. 36	CTD-group	elementary	learning disabled	Harrell, Wolery, Ault, Demers, & Smith (1991)
Coins	A. word B. pennies	verbal flash card	63.1	CTD-group individual	preschool	language/hearing impaired	Wolery, Werts, Holcombe, Billings, & Vassilaros (1991)
Numerals	word	flash card	NA	CTD-group	preschool	mild	Holcombe, Wolery, Werts, & Hrenkevich (1991)
Labeling photos	word	verbal	NA	CTD-group	preschool	moderate	Wolery, Doyle, Ault, Gast, Meyer, & Stinson (1991)

Note. CTD=constant time delay
PTD=progressive time delay
SLP=system of least prompts
TBT=transition based teaching
CAI=computer aided instruction

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Answers to Self Test

1. Instructive feedback

2. b

3. a. The student does not respond directly to the extra information.
   b. No reinforcement is provided for learning the extra material.

4. Answers may vary.
   The material must be:
   - developmentally appropriate
   - consistent with student's IEP goals.
   - consistent with student's sensory systems
   - discrete rather than chained tasks
   - of an interest to the student.
   - consistent with the curriculum.

5. F

6. F

7. T

8. b

9. Monitoring

10. a. probing
    b. daily monitoring

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Appendix A

Studies Concerned with Instructive Feedback

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Appendix B

Consequent Event Manipulation Manual

(Manual for dissemination is spiral bound)

Using Attending Cues and Responses to Increase the Efficiency of Direct Instruction

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1992

Learning Efficiently: Acquisition of Related Non-Target Behaviors

Project LEARN

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Using Attending Cues and Responses to Increase the Efficiency of Direct Instruction

Ariane Holcombe-Ligon, Mark Wolery, Margaret Gessler Werts

1992

Purpose of the Manual

This manual describes how to use attending cues and responses to increase the efficiency of direct instruction. The manual is designed for use by practicing teachers, students who are learning to become teachers, and faculty members who instruct such students. Our intent is to disseminate the information from our research to as many individuals as possible; therefore, we give permission for users to reproduce the document and to use it, in whole or in part, in their own training and research activities. We request, however, that any reproductions maintain the authorship of the manual, and that it contain an acknowledgement and disclaimer that manual was developed by the a grant (Project LEARN, Grant Number H023C00125) from the U.S. Department of Education.

Description of the Manual

This manual contains several sections: (a) background information describing the importance of attention and of direct instruction, (b) definition and description of various attending cues and attending responses and a taxonomy of those cues/responses, (c) information on how to use attending cues/responses to increase the efficiency of instruction, (d) a summary of some of the related research, (e) references for the literature that is cited, and (f) self-tests for checking the reader's understanding of the content.

Disclaimer and Acknowledgements

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Using Attending Cues and Responses to Increase the Efficiency of Direct Instruction

Have you ever said or heard a teacher or parent say any of these comments? "He just doesn't pay attention." "He can learn whatever he wants to learn when he pays attention." "If she would just attend to what I am teaching, ..." "She really attends to ..., but doesn't attend to ..." "At first he didn't attend to what we were doing, but then ..." "She seems to attend, but she just isn't getting it." Nearly all parents, teachers, administrators, and researchers recognize that when students attend to the instruction, they are more likely to learn. We also recognize that paying attention may not be enough to ensure learning. Some students appear to be paying attention to the learning activities and materials, but do not seem to be making adequate progress.

A lot of research has been conducted and a lot has been written about students' attention (Rinne, 1984; Wolery, Bailey, & Sugai, 1988). This work has focused on three distinct but related areas. First, a lot of effort has been devoted to increasing students' on-task behavior (attention) to deal with problem behavior or potential problem behavior in classrooms (Rinne, 1984). If you are a highly accomplished and experienced teacher or if you talk with such teachers, you recognize that getting students involved in classroom activities will reduce the chances of students becoming disruptive and engaging in other problem behaviors. You probably also realize that keeping children busy and participating in interesting activities is one of the best ways available to control students' problem behavior (Wolery & Winterling, in press). The old saying, "idleness is the devil's workshop" reflects this belief. It suggests that when children do not have interesting and constructive things to do, then they are likely to find something interesting to do, and what they find will often be disruptive or unproductive.

A second area in which students' attention has been the topic of study deals with the assumption that if students are engaged and participating (attending) in classroom activities, to the teachers, or with instructional materials, then their chances of learning are increased (McWilliam, 1991; McWilliam & Bailey, 1992). Again, if you are a highly accomplished and experienced teacher, you realize that students are more apt to learn the things we want them to learn if they are engaged in the activities designed to teach them those important skills. So, if students are attending to the classroom activities, the teacher, and/or the materials, they are less likely to engage in problem behaviors and are more likely to learn what we want them to learn.

The third area in which students' attention has been studied deals with whether students are attending to the important aspects of the instructional activities (Cooper, Heron, & Heward, 1987; Wolery, Ault, & Doyle, 1992; Wolery, Bailey, & Sugai, 1988). In other words, it is not enough to have children participate in the activity, they must also attend to what is being taught. Again, if you are a highly accomplished and experienced teacher or if you talk with such teachers, you will realize that sometime students participate in activities, but do not seem to learn from them. For example, elementary-aged students may read a passage from a book, but may not learn the important points from that passage; or, preschool children may play in the block area, but may not learn about the relationship of different sized blocks to one another - or they may play in the socio-dramatic play area, but may not learn to interact with their peers.

Thus, attention is important for children with and without disabilities across a wide age range (i.e., young preschool children, elementary-aged children, and secondary students). Highly skilled teachers, focus on their students' attention to decrease the occurrence of problem behaviors, to increase the chances that students will learn, and to ensure that students are attending to the critical or important aspects of the instructional activities and materials. Most accomplished teachers use a number of different strategies, techniques, and procedures for increasing children's attention in each of these areas. And, it seems that those teachers do this almost automatically. However, they probably learned how to promote students' attention by watching and talking with more experienced teachers, from reading books and articles about it, and through experience - trying things out and keeping what works and discarding what does not work.

Purpose of This Manual

To describe all of the procedures skilled teachers use to help students attend would require many books. So, a short manual, such as this one, cannot deal with everything that is important about students' attention. As a result, this manual has two specific purposes:

1. We describe how to use attending cues and responses to help children attend to the important aspects of instructional activities, and

2. We describe how to use attending cues and responses to help children learn extra behaviors that you are not teaching them directly.

Organization of This Manual

Before we describe what attending cues and responses are and before we describe how to use them, we will present the situations and context in which they should be used. These procedures are very useful in some situations, but they have specific applications and do not address many of the aspects related to attention mentioned above. For example, they are not designed to control problem behavior by increasing students' attention and they are not designed to promote children's general participation in activities. Rather, they are designed to help children attend to the critical aspects of the skills being taught and to help children learn extra information about those skills.

After the situations in which the procedures should be used are described, we will define attending cues and responses and explain a classification system for deciding which attending cues and attending responses to use. The third part of the manual describes steps for using attending cues and attending responses to increase the efficiency of direction instructional activities. The final section of the manual is a summary of the research related to using attending cues and responses. We have included self-tests throughout the manual so that you can check your understanding of the content as you read it.

Context for Using Attending Cues and Responses

Before we describe what attending cues and attending responses are and how to use them, it is important for us to describe the situations and contexts in which they should be used. As you know, teaching involves making many complex decisions. Some of the questions that you have probably asked many times and are often faced by teachers are:

- What skills are really important for my students to learn?
- How should I arrange my classroom so that they are likely to learn those skills?
- How should I schedule my time and their time so that they will learn those skills?
- What materials would be best used to teach them those skills?

- Which instructional strategies should I use to teach them those skills?
- What will motivate my students to learn the important skills?
- How can I evaluate whether they have learned the skills and can go on to other important skills?

These questions and their answers for teachers of children with disabilities have been discussed in several sources (e.g., Bailey & Wolery, 1989, 1992; Barnett & Carey, 1992; Bricker & Cripe, 1992; Carnine, Silbert, & Kameenui, 1990; Cooper et al., 1987; Mercer & Mercer, 1989; Odom & Karnes, 1988; Safford, 1989; Snell, 1987; Wolery, Ault, & Doyle, 1992; Wolery, Bailey, & Sugai, 1988 and many others). Thus, we do not discuss these issues here, but as you realize, they are critical questions and how you answer them and act on them will influence how much children learn and how quickly they will learn it.

Given that you have identified important skills for your students to learn, given that you have arranged your classroom to improve their chances of learning those skills, and given that you have scheduled your time and children's time while they are in the classroom, you are faced with choices about how to actually implement the instruction. For some skills and some children, we use child-directed and self-guided learning. For other skills, we use strategies that can be implemented while children are engaged in child-directed learning activities. For other skills, we used direct instruction.

The procedures described in this manual are designed for use in direct instructional activities. Such activities are used with individual students, small groups of students, or with large groups of students. Attending cues and attending responses can and should be used in direct instructional sessions. It is fair to ask, "What do you mean by 'direct instructional activities/sessions'?" In this section, we answer that question.

What Is "Direct Instruction"?

Direct instruction includes many components. When we use the term, we mean four things. These are described below.

1. Teachers have identified some important behaviors that their students should be taught.

The important behaviors that we identify for students often can be grouped into two broad categories: (a) discrete behaviors, and (b) chained behaviors. Discrete behaviors are those responses of students that are relatively brief and usually involve only one behavior. Naming a picture, letter, numeral; reading a sight word, answering a question with one or two words, and many other important skills are examples of discrete behaviors. Chained behaviors are those skills for which the student puts a number of different behaviors together in a sequence to form a complex behavior. For example, reading the words of a sentence, putting on a coat, eating a meal, completing a math problem that involves several steps are all chained responses. They involve several behaviors or steps done in sequence to complete some task. The procedures described in this manual are designed for use primarily with discrete behaviors, but they can also be used with short chains of behaviors. For example, they are often used in teaching spelling - which involves saying, writing, or typing a number of letters in a given sequence.

2. The direct instructional sessions are usually relatively short.

The length of any instructional activity may vary greatly. As you know, how long an instructional activity occurs depends upon the time available, the skills being taught, the ages and abilities of the students, and other issues. Direct instructional activities are no exception, however, they are usually relatively short (e.g., 2 minutes to 15 minutes). Usually, with younger children, the sessions are shorter; and often with children who have more severe disabilities, the sessions are shorter. How long the sessions should last is left to the teacher, but usually, they should be short so that students will enjoy them, readily attend to them, and will not become bored with them.

3. Direct instructional activities involve use of a defined trial sequence.

A trial is simply a single opportunity for the student or students to respond. A trial sequence is a list of steps the teacher goes through in presenting the information to students. When watching many teachers provide direct instruction, we often see them do the following steps:

(a) They secure the students' attention,

(b) they present some stimulus or question to the students,

(c) they give the students an opportunity to respond,

(d) they may provide students with help in answering or responding correctly, and

(e) they provide feedback to students on the correctness of their responses (e.g., the praise students when the response is correct and they often tell students how to do the behavior if the response is not correct).

Of course, as you know, there are many variations to the general steps listed above. The procedures for using attending cues and responses described in this manual deal with that first step (i.e., Step "a" - securing students' attention). In direct instructional sessions, this trial sequence may be repeated several times (e.g., 10 to 20 times). Different behaviors may, and probably should, be taught within each session, but the trial sequence may be the same for each of several behaviors being taught.

4. Direct instructional activities involve active responding from students.

Direct instruction, as we use the term in this manual, is not lecturing or simply telling students about some fact or content. Rather, as described in the steps of the trial sequence, it involves giving students opportunities to respond. In some cases, individual children respond on each trial. When individual responding is used, the teacher may randomly pick which student will respond on each trial. When this is done, the students may not know when it will be their turn to answer - so the teacher has to signal them. Another way to present individual trials is to use round-robin responding. With this method, the teacher goes in a predictable order (e.g., from left to right) and each child can learn when it will be their turn. With either method of individual responding, the teacher should try to get all of the children to pay attention during the entire session, even when it is not their turn. Another method teachers use is to have all children respond on all trials. This is known as choral or unison responding. The advantage of individual responding is that each student can be taught different behaviors at the same time. The advantage of choral (unison) responding is that all children are responding more frequently - they do not have to wait for their turn.

Regardless of the method used for having students to respond during direct instructional activities, a couple things are important. First, the trials should be presented at a rapid and brisk pace. While it is possible to present things to rapidly, a rapid pace of presenting trials and having students reponed quickly seems to be associated with more learning, more attention, and less opportunities for children to get bored or distracted. Second, when presenting direct instructional trials, they should be done so that children will be able to respond successfully and correctly. This does not mean that the sessions should involve teaching children what they already know. Rather, it means that children have the entry level skills needed to respond correctly and that the teacher will provide help (often called prompts) when children do not respond correctly and quickly. Many strategies exist of presenting and removing or fading such help (see Wolery, Ault, & Doyle, 1992 for a discussion of these procedures).

In summary, direct instruction involves teachers attempting to teach specific behaviors to students in relatively short sessions using a trial sequences of several steps that are repeatedly presented and that allow students to respond actively, repeatedly, and successfully. Direct instruction is only one of many different types of teaching. But, as you probably know, it has been used successfully to teach (a) learners who have almost any disability including those with learning disabilities, speech/language disorders, mental retardation, behavior disorders, sensory impairments, and physical impairments; (b) learners who have mild, moderate, and severe expressions of these disabilities; (c) learners from a broad age range from preschoolers to adults; and (d) learners who need to acquire a broad range of skills. Thus, teachers of students with disabilities should know how to use direct instruction.

Direct instruction, as with all other instructional methods, should be evaluated on many different dimensions. For example, we need to be sure that our instructional methods are appropriate for the students and skills being taught, that the family members of the students are pleased and satisfied with the teaching strategies, that the children are participating appropriately in the activities, that the instruction is as normalized as possible, that children are treated with dignity and respect, and many other issues. However, two other issues are particularly important; these are: effectiveness and efficiency. These are discussed below.

Effectiveness refers to whether children are actually learning the skills being taught. If instruction, regardless of the methods being used, is not effective, then it should be adjusted. There are few defensible reasons for using instructional procedures, including direct instruction, when it is not producing desired and positive changes in the skills of students. Of course, effectiveness should be evaluated in terms of whether children learn the skills you are teaching, and whether they are using those skills when and wherever it is appropriate to use them.

Efficiency, however, is somewhat different. Efficiency refers to the relative value of one instructional methodology over another. Efficiency involves at least two components: First, before an instructional method or practice can be called "efficient," it must be effective - it must result in children learning the behaviors being taught. Second, before an instructional method or practice can be called "efficient," it must result in learning that is superior to some other instructional method.

At least two ways exist for evaluating whether one procedure is more or less efficient than another. We can say a strategy is efficient when it results in more rapid learning than some other strategy. For example, if you are trying to teach a group of students some important skills, and one strategy would allow you to accomplish this with 30 minutes of instruction and another would require 60 minutes, then the more efficient strategy would be the one that required only 30 minutes. This dimension of efficiency is often measured in terms of the number of sessions, number of trials, and number of minutes of instruction to criterion. The practice or method that results in more fewer sessions, trials, and minutes of instruction is the one that is more efficient and is recommended for later use.

The second way to measure and judge whether one strategy or practice is more efficient than another deals with how many behaviors are learned. Two strategies or practices may result in children learning a given set of skills in about the same amount of time (i.e., produce equally rapid learning), but one strategy may allow children to learn other skills as well. For example, teaching elementary-age children with moderate mental retardation to each read a list of six food words for shopping in the grocery store could be done individually or in a small group. It may require 40 minutes of instruction to teach a given child to read her list of six words in one-on-one (individual) instruction, and it may require 40 minutes of instruction to teach her those six words in a small group. However, if the other children in the group are being taught other food words, she might observe this and learn some of their words. Thus, in the individual sessions, she could only learn the six words, but in the small group sessions, she might learn 8 or 10 or more words. If this occurred, then the small group instructional session would be considered more efficient, because she learned more behaviors in about the same amount of time. Some of these behaviors were taught directly (target behaviors) to her and others were not taught directly (non-target).

The remainder of this manual is devoted to explaining how attending cues and responses can be used in direct instruction trials to increase the efficiency of learning. The procedures focus on both aspects of efficiency - increasing how rapidly children learn and increasing the number of behaviors they can learn. However, before you read any further, we present several questions you can ask yourself to ensure you mastered the content that has already been described.

Self-Test # 1: Questions

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1. Highly accomplished and skilled teachers focus on students' attention in at least three areas (or for three reasons). What are these?

2. What are some questions that teachers face when planning their teaching activities?

3. In what type of instruction should attending cues and responses be used to increase its efficiency?

4. What are the four defining components of direct instructional activities?

5. List and define the two major types of behaviors that can be taught through direct instruction.

6. What is a "trial sequence" and what are some common steps of those sequences?

7. When presenting direct instruction in small groups, what are the two ways students respond?

8. Define effectiveness and efficiency.

9. List two ways that the "efficiency" of an instructional practice can be measured.

Answers to these questions are provided on the next page.

Answers to Self-Test # 1 Questions

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1. Highly skilled teachers, focus on their students' attention for three reasons:
   (1) to decrease the occurrence of problem behaviors,
   (2) to increase the chances that students will learn, and
   (3) to ensure that students are attending to the critical or important aspects of the instructional activities and materials.

2. Teachers face many questions when planning their instructional activities, several of these were listed on pages 3 and 4; others, of course, exist.

3. Attending cues and responses should be used to increase the efficiency of direct instructional activities.

4. The four defining components of direct instruction are:
   (1) Teachers have identified some important behaviors that their students should be taught;
   (2) Direct instructional sessions are usually relatively short.
   (3) Direct instructional activities involve use of a defined trial sequence.
   (4) Direct instructional activities involve active student responding.

5. The two types of responses taught through direct instruction are (1) discrete behaviors - students' responses that are relatively brief and usually involve one behavior; and (2) chained behaviors - students' responses that require a number of behaviors to be performed in a sequence to complete a skill or task.

6. A trial sequence is a list of steps the teacher does when presenting information to students in direct instruction. Common steps are (a) securing students' attention, (b) presenting a stimulus or question, (c) providing students with an opportunity to respond, (d) providing help as needed to ensure correct responding, (e) providing feedback for students' responses.

7. When presenting direct instruction, students can (1) respond individually or (2) chorally (i.e., in unison).

8. Effectiveness means that children learn the behaviors that are taught. Efficiency means that one instructional strategy, method, practice results in superior learning to some other strategy, method, or practice.

9. The efficiency of instructional practices, methods, or strategies can be measured (a) by comparing how rapidly children learn the skills being taught (e.g., how many sessions, trials, or minutes of instruction are required to reach criterion), and/or (b) by comparing how many behaviors (target and non-target) are learned within a given amount of time.

Definition and Description of Attending Cues and Responses

At this point you may be asking, "What are attending cues and attending responses?" Actually, they are things that teachers and students do quite often during direct instruction, and they occur early in the trial sequence.

Definitions

ATTENDING CUES are the behaviors teachers do to get children to look at, listen to, or otherwise orient toward or focus on the teachers' question or the stimulus the teacher is presenting. For example, when you are teaching a single child or a group of students, you have probably said, "Look.", "Listen.", "Get ready.", "Let's start.", or similar statements. Also, you may have asked, "Are you ready?", "Are you looking?", "Who can tell me?" Each of these are attending cues. What we try to communicate to students is: "Pay attention; this is important; get ready to learn/respond."

ATTENDING RESPONSES are the behaviors children do in response to attending cues. For example, they may stop what they are doing and listen attentively, they may look at you, or they may look at what you are holding. Each of these are examples of attending responses. Attending responses give you some indication that the students are ready to receive instruction, and ready for you to proceed with the presentation of the information you are trying to teach.

Selecting Attending Cues and Responses

Attending cues are important in direct instruction because they can be used to capture and/or focus students' attention. Attending responses are important in direct instruction because they given the teacher an indication that the child is ready to perform. As noted, teachers use attending cues, and students perform attending responses. Whether and which attending cues teachers use will vary depending upon what is being taught, the students' abilities and experiences, and how easily distracted the students are. Whether teachers require an attending response is dependent upon how attentive the children usually area, whether children are having difficulty learning a given behavior, and many other factors. It is important to note that attending cues and responses should only be used to enhance the effectiveness and efficiency of direct instruction. They should not be used when they seem to interfere or break the flow of responding.

In direct instruction, you initially need to make two major decisions. The first decision is whether to use an attending cue. Given that an attending cue will be used, then your second decision is to decided when you are going to use it. In our own teaching and in watching other teachers, attending cues appear to be used at three times: (a) only at the beginning of each direct instructional session, (b) at the beginning of each session and during the sessions whenever students seem inattentive, and (c) on every trial. This decision is made based on what is required to ensure that students attend to the instructional tasks and stimuli. The procedures described later are designed for using attending cues on every trial.

Given that you are going to use the attending cue on each trial, then three other decisions must be faced. These are: (a) will I use the same attending cue on each trial, (b) what type of attending cue will I use, and (c) what type of attending response will I require of my students? To help describe the possible answers to these questions, the table on the next page was constructed. Attending cues and responses are classified in this table. This classification system has two major parts: presentation variables and response variables. The presentation variables deal with the first two questions ("Will I use the same attending cue on every trial?" and "What type of attending cue will I use?"). These choices are presented on the left-hand side of the table. The response variables deal with the third question ("What type of attending response will I require of my students?"). The choices of attending responses are presented across the top of the table. Note that the table contains examples of the possible combinations; the examples are developed for sight word reading as the target behavior. For other behaviors, some changes would be required in the behaviors used by teachers.

Let's take each question separately starting with those that focus on the teacher's presentation of attending cues. The first question is, "Will I use the same attending cue on each trial?" The table contains two answers to this question: "yes - same for each trial," and "no - different across trials." If you use the same attending cue on each trial, it is easier; however, with repeated use, it may loose its ability to capture and focus students' attention. With other children, the same attending cue on each trial will be perfectly fine. It will be sufficient to orient them to the target stimulus. If you choose to use a different attending cue across trials, then you need to prepare a list of the attending cues you will use.

Taxonomy of Attending Cues and Attending Responses

Presentation Variables	Response Variables			
Type Across Trials Nature of Cue	Individual		Group	
	Active	Inactive	Active	Inactive
Same for Each Trial				
General	On each trial the teacher says, "Look" & only the target student must look at the stimulus	On each trial the teacher says, "Time to work" & no response is required of any student	On each trial the teacher says, "Look" & all of the students must look at the stimulus	On each trial the teacher says, "Time to work" & no response is required of any student
Specific	On each trial the teacher says, "Name the letters" & only the target student names the letters	On each trial the teacher says, "Look" to the target student & the teacher names the letters	On each trial the teacher says, "Name the letters" & all group members name the letters	On each trial the teacher says, "Look" to the group and the teacher names the letters for the group
Different Across Trails				
General	Across different trials, the teacher says, "Look," "Touch," "Hold," or "Listen" (1 per trial); & only the target student must comply with the cue	Across different trials the teacher says, "Time to work," "Let's start," "I'm ready" (1 per trial); and no response is required of any student	Across different trials the teacher says "Look," "Touch," "Hold" or "Listen" (1 per trial); & all students must comply with the cue	Across different trials the teacher says, "Time to work," "Let's start," "I'm ready" (1 per trial); & all students must comply with the cue
Specific	Across different trials, the teacher says, "Name the letters," "Match," or "Trace these" (1 per trial); & only the target student must comply with the cue	Across different trials the teacher says, "Look" or "Listen" to the target student & the teacher names, matches, or traces the stimuli (1 per trial; no response required of student	Across different trials the teacher says "Name the letters," "Match," or "Trace these" (1 per trial) & all students must comply with the cue	Across different trials the teacher says, "Look" or "Listen" to group & teacher names, matches, or traces stimuli (1 per trial) for all students; no response is required of any student

The second question asks, "What type of attending cue will I use?" Two choices are provided: general and specific. General attending cues orient students' attention to the task you are presenting or the question you are asking; specific attending cues orient students' attention to the critical features of the task or stimulus. For example, if you are teaching sight word reading, then saying, "Look" as you hold up a sight word is a general attending cue. It tells the students to look at what you are holding, but it does not call attention to the specific aspects of the word that is on the card you are holding. The specific attending cue, however, may involve you saying, "Say the letters of this word." In this case, your attending cue is calling attention not just to the card you are holding up, but to what is on the card. Often, general attending cues are easier to design and use, and if students readily learn when they are being used, we recommend that you employ them. However, when children are having difficulty learning or when progress is slow, we recommend use of specific attending cues.

After you have determine whether you will present the same attending cue on each trial or a different one and after deciding whether to use a general or specific attending cue, you need to determine how you will have the students respond to the attending cue, and this involves asking two questions: "Will I have students respond individually or as a group to the attending cue?" and "Will I have them respond actively or inactively?" As noted earlier, when presenting direct instruction to a group of students, they can respond to the target behavior individually or chorally; and with individual responding, trials can be presented in round-robin or random order. With attending cues, regardless of the type of responding you are having students do to the target question, you can use either individual or group responding. For example, if you are having students respond individually to the task direction or question, you can have them respond as a group or individually to the attending cue. Usually, it seems desirable to have group responding, particularly when using general attending cues. For example, having all children look at a stimulus even if it is a given child's turn may increase the likelihood that all children will learn that child's behavior. A trial sequence with a group attending cue and individual responding may go like this: The teachers holds up the stimulus card, says, "Everybody Look," checks to see that each child is looking, and then says, "John, what word is this?" John would be given a chance to answer or would be prompted to answer, and then he would be given feedback (e.g., praise for a correct response, and a correction for an error response). Although all the students had to respond to the attending cue, only John had to respond to the target stimulus or task direction.

Once you have decided whether to have children respond individually or as a group to the attending cue, you still have one more question to answer, "Will I require an active or inactive attending response?" Active attending responses require the child to "show" you in some what that they are attending. This may involve looking at the stimulus, looking at you, and many others. An inactive attending response does not require the child to change what they are doing after you present the attending cue. Generally, we recommend using active attending cues, but a lot of this depends upon how readily children attend, whether they are making rapid progress in learning the target behaviors, and what they are used to doing.

The general guideline for using attending cue and attending responses in direct instruction is as follows:

> **"Use the quickest and easiest attending cue and response necessary to ensure that students orient toward the target stimulus."**

What is important is whether students are learning the target behaviors; attending cues and attending responses are simply tools that the teacher has to help ensure that students are responding appropriately.

For review, several points should be made. As noted, attending cues and responses can be used only at the beginning of the direct instruction session, when children seem inattentive, or on every trial. If you decide to use attending cues and responses on every trial, you need to make several decisions. First, you need to decide whether you will use the same attending cue on all trials or whether you will use different ones across trials. Second, you need to decide whether you will use a general attending cue or a specific attending cue. Third, you need to decide whether individual children will respond to the attending cue or whether the whole group must respond. Fourth, you need to decide whether you will require an active or inactive attending response. Before you read how to use attending cues and attending responses to increase the efficiency of instruction, you may want to take "Self-Test # 2."

Self-Test # 2: Questions

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1. What are attending cues?
2. What are attending responses?
3. When are the three times teachers often use attending cues and attending responses?
4. List the questions you must ask yourself when planning to use attending cues and responses on every trial?
5. What is the primary difference between general and specific attending cues?
6. What is the primary difference between active and inactive attending responses?
7. Give an example of a general attending cue delivered the same on every trial with a group inactive attending response.
8. Give an example of specific attending cues delivered differently across trials requiring an individual and active attending response.
9. What is the general guideline for deciding which attending cues and attending responses to use?

The answers are provided on the next page.

Answers to Self-Test # 2 Questions

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1. Attending cues are the behaviors teachers do to get children to look at, listen to, or otherwise orient toward or focus on the teachers' question or the stimulus the teacher is presenting.

2. Attending responses are the behaviors children do in response to attending cues - these responses are designed to "show" the teacher that children are attending.

3. Teachers often use attending cues and responses at three times:
   (1) Only at the beginning of sessions,
   (2) Only when children appear inattentive, and
   (3) On every trial of the direct instruction session.

4. The questions teachers must ask in deciding whether to use the attending cues and attending responses are:
   (1) When am I going to use attending cues/responses?
   (2) If I am going to use them on every trial, will the attending cues be the same on every trial or different across trials?
   (3) If I am going to use them on every trial, will the attending cues be general or specific?
   (4) If I am using attending cues on every trial, will I have individual students or the group respond to the attending cue?
   (5) If I am using attending cues on every trial, will I require students to use active or inactive attending responses?

5. The primary difference of a general rather than specific attending cue is that the general attending cue calls the students' attention to the stimulus, and the specific attending cue calls the students' attention to the important aspects of the stimulus.

6. The primary difference of an active versus inactive attending responses is that students are required to engage in some behavior that shows they are attending with an active response, but are not required to do such a behavior with an inactive attending response.

7. On each trial the teacher says, "Time to work." and no response is required of any student.

8. When teaching sight words, it might be: Across different trials, the teacher says, "Name the letters," "Match these," "Trace these letters" (each cue being delivered on different trials, but only one per trial), and only the target students (i.e., the one who is supposed to answer) must comply with the attending cue by naming the letters, matching them, or tracing the letters.

9. The general guideline for using attending cues and responses is: Use the quickest and easiest attending cue and response necessary to ensure that students orient toward the target stimulus.

Increasing Efficiency by Using Attending Cues and Responses

As noted earlier in this manual, direct instruction should be evaluated on several aspects, and one of these is its efficiency. Efficiency requires that the instruction be effective and that it be superior to some other strategy. To measure the efficiency of instruction, we can determine how rapidly children are learning and we can measure whether the instruction is resulting in children learning the behaviors that are taught directly and behaviors that are not taught directly. Attending cues and responses have been used to promote each type of efficiency. In the following sections we deal with each type.

Using Attending Cues/Responses to Increase the Rapidity of Learning

To ensure rapid learning in direct instruction, you must consider several things. These include (a) teaching skills that are on an appropriate level for the children (i.e., those for which they have mastered the prerequisite skills); (b) ensuring that children are attending to the stimulus; (c) providing children with sufficient opportunities to respond; (d) providing students with prompts or help so that they can respond correctly; (e) fading and removing the prompts or help you give students systematically so that they respond independently and correctly; and (f) using effective feedback in the form of reinforcers (Wolery, Ault, & Doyle, 1992; Wolery, Bailey, & Sugai, 1988). However, over the years, we have occasionally encountered students who were being taught the appropriate skills, but they were not making rapid progress. Their teachers were using instructional strategies that had been effective with a lot of similar students and with the skills being taught. Their teachers also were using those strategies correctly and were using reinforcers that were effective in other instructional programs. Yet, progress was very slow or almost non-existent.

In trying to solve this problem and present the instruction so that the children would learn rapidly, we have often manipulated the attending cues and responses. Frequently, when children were not making progress, their teachers were using general attending cues (e.g., having students look at them or at the stimulus). The students were looking, but from trial to trial it appeared that they were not paying attention to the important aspects of the trial. As a result, we have often begun to use specific rather than general attending cues. For example, during the initial instruction, the teacher would say the child's name and then say, "Look." The child would look at the stimulus or at the teacher, then the teacher would say, "What is this (word, number, or whatever was being taught)?" The child would often respond incorrectly. This is an example of using a general attending cue with an active attending response. We often changed the trial sequence to include a specific attending response.

The new trial sequence would occur as follows: The teacher would hold up the stimulus, put two cards on the table one identical to the stimulus and one different from it. The teacher would then say the child's name and give them the stimulus and say, "Put it on the same." The child then would have to look at the stimulus and match it to one of the two that were on the table. When the student made a correct match, the teacher would say, "What is this (word, number, or whatever was being taught)?" The use of this specific matching attending cue and response often resulted in children learning.

The conclusion we made from having several of these experiences was that sometimes children were not attending to the critical aspects of the stimuli being taught. When they were required (i.e., through the active attending response to a specific attending cue) to attend to the important aspects of the stimulus, they often began to learn rapidly. This has worked with other specific attending cues such as saying the letters of a sight word they were being required to read, imitating the teacher saying the letters in sequence, tracing with their finger the letters, writing the letters down, and so on. Other specific attending cues/responses, have been to require students to repeat the task direction. For example, if you are teaching students basic math facts (e.g., two plus two equals? and eight minus five equals?) having the child restate the problem before answering can be used as a specific attending cue and active attending response. The point is that specific attending cues and active attending responses appear to focus students attention on the parts of the stimulus that were important.

Remember that we stated a general guideline about using attending cues and responses. That guideline was: "Use the quickest and easiest attending cue and response necessary to ensure that students orient toward the target stimulus." With students who are not making progress, but are being taught appropriate skills with otherwise effective strategies and with powerful reinforcers, we recommend a second guideline:

> **"Use specific attending cues and active attending responses that demonstrate clearly that the student is attending to the critical aspects of the stimulus."**

Thus, with most students and most direct instruction programs, we use general attending cues because they are quick and easy to implement. And, with most students, they are sufficient to ensure that students are attending. However, when students are not making progress, we then often move to an attending cue and attending response that makes them show us they are attending to the important aspects of the stimulus. When we do this, students often begin to learn more rapidly and we have increased the efficiency of our instruction!

Using Attending Cues/Responses to Teach Target and Non-Target Behaviors

Another way to increase the efficiency of instruction is by helping children to learn their target behaviors and other behaviors that are not taught directly. There are actually two ways to do this. The first is to use instructive feedback which involves adding extra, non-target stimuli or information to the feedback after students respond. For more information on this procedure see the companion manual for this one; it is titled: Instructive feedback: Increasing opportunities for learning through the addition of incidental information (Werts, Wolery, & Holcombe, 1991).

The second way to do this is to put the additional, non-target information in the attending cues and/or the attending responses. For example, when teaching children to read sight words, teachers have used various forms of spelling as attending cues and attending responses. For example, at the beginning of the trial, the teacher says, "Say these letters." (specific attending cue), and has the child say the letters of the word in order (active attending response). This has resulted in children not only learning to read the sight words, but also learning to spell some of the words. The sight words are the target behaviors, and the spelling is the related, non-target behaviors. Another variation in the same task is to have children repeat the letters as the teacher says them, and still another variation is to have the children write the letters. Although much of the research that has focused on adding non-target behaviors to the attending cues and responses have focused on sight word reading and spelling, this is by no means the extent of the potential applications. Other possible examples include embedding synonyms or antonyms in the antecedent event when teaching sight words, naming the color of shapes when teaching expressive identification of shapes, providing labels of objects when teaching children to identify colors, and providing short statements about objects or pictures when teaching children to label those objects or pictures.

In some cases, you might provide a specific attending cue, but not require an attending response beyond looking and listening. For example, if you were teaching children to label photographs of various occupations, you could use a specific attending cue such as stating factual information about the occupation. If one of the photographs was of a mechanic, the extra information inserted into your specific attending cue might be "This person fixes cars." The children would not be required to perform an active attending cue beyond looking at the card. However, it is possible that they would learn to not only name the occupations taught directly to them, but also to learn the factual (non-target information) that you presented in your specific attending cue.

When adding this extra, non-target information into the attending cues and/or attending responses, you will needed to make several decisions. These are:

- What extra information will be presented,
- how many different pieces of information will be presented,
- on which trials will the information be presented,
- in what mode will the information be presented,
- what child response is expected, and
- how the information will be assessed.

Each of these issues are discussed in the following paragraphs.

What incidental information will be presented?

Once the target behavior has been identified and other relevant decision have been made (e.g., which instructional strategies to use, whether to teach in a small group, when to teach, etc.), you must decide what non-target information will be included in the trial sequence. In the existing research, discrete behaviors or small chains of behaviors have been provided as the non-target information. These types of behaviors appear to be well suited to the this method, because they take minimal time to include in the trial sequence. As a result the length of the session is not increased substantially. Another issue to consider when selecting non-target information is how related it is to the target behavior. Specifically, whether it comes from the same curricular domain and whether it is conceptually related to the target behavior. For example, when the target behavior is reading sight words, you may ask the student to name the letters in the word prior to asking him to name the word. In this example, the non-target information would be spelling and the behavior being taught directly would be the sight word, but they are highly related to one another.

How Many Pieces of Information Will Be Provided?

In most cases only one extra non-target, piece of information would be added for each behavior that is taught directly. However, there are exceptions. For instance, in the earlier example where the teacher was teaching the students to name the occupations depicted in pictures and was presenting factual statements as the non-target information. The teacher would need to present at least two extra, non-target statements for each picture. If he did not, the students may learn to say, "Mechanic" each time the teacher said, "This person fixes cars" but they may not learn to label the picture. That is, they could only be responding to the factual information presented. Therefore, on some trials the teacher might say, "This person fixes cars," but on other trials say, "This person works in a garage." Of course, other statements could also be added (e.g., "This person uses wrenches" or "This person repairs trucks."). To date, little research has addressed this issue.

As another example, if you were teaching the sight word "large", you might model the correct spelling on every trial, or you may model the spelling of the word on half of the trial presentations and state the antonym (i.e., "Small") on the remaining trial presentations. The first trial may go like this: "The letters in this word are l-a-r-g-e. What is this word?", the second trial may be: "The opposite of this word is "small". What is this word?". In this example the task direction is "What is this word?" The extra information is the spelling of the word large and the antonym "small".

When making the decisions of how many pieces of extra information to present, you should consider (a) the learning abilities of individual children, and (b) the number of target behaviors to be instructed. Older children or children who learn rapidly may be able to learn more pieces of extra information. However, children who have difficulty learning target information or who are slow learners may benefit from the addition of only one piece of extra information.

Which trials will receive the extra information?

This decision must be made with consideration of the previous decision regarding how many pieces of extra information are presented. If several different pieces of non-target information are being taught in one instructional session, you may decide to present it on each trial so the children will have more exposure to the non-target information. However, if you have planned for a long instructional session, you may choose to present the extra information on only half of the instructional trials. Research to date has not evaluated all of these possibilities. The current research has presented extra information on every trial.

What mode of presentation will be used?

As you are selecting the extra information, decisions must also be made on the mode of presentation. You may provide a visual model, a verbal model, or a combination of the two. In the existing literature, Alig-Cybriwsky, Wolery, and Gast (1990); Gast Doyle, Wolery, Ault, and Baklarz (1991); and Wolery, Ault, Gast, Doyle, and Mills (1990) provided a verbal and a visual model. They were teaching sight word reading, and showed a card with the word on it and then said the letters in the word. However, Gast, Ault, Wolery, Doyle, and Belanger (1988) only provided a verbal statement. They were teaching students to read words for various foods, and they told the students the type of food each word represented. Keel and Gast (1992), Winterling (1990), and Yancey (1987) provided only a visual model. For example, in teaching sight word reading, Winterling had the students write the letters from a visual model before being asked to read them. In practice, the mode of the presentation will depend a great deal on what the target behaviors are and what the extra, non-target information is.

What student response will be required?

After determining the extra information and the presentation mode, child responses must be determined. Specifically, you must determine whether the child will be required to make an active response to the extra information or an inactive response. Of the eight studies with extra information in the antecedent event, Gast et al. (1988) and Gast et al. (1991) were the only studies which required an inactive student response. In these studies the teacher verbally presented the extra information and the student made no response related to that information. For example, in Gast et al. (1991) the teacher instructed the child to look at a flash card of a word and then named the letters in the word. The child was not required to make any response. In the remaining five studies children were required to make an active response such as saying or writing the letters in the target word. In the Winterling (1990) study, the teacher told the child to look at a flash card of a word and then told the child to write the word. An active response, writing the word, was the extra information. After the child wrote the word, the teacher gave a task direction asking the child to name the word.

The decision to have the child make an active response may be based on the additional length of time that an active response may add to the instructional session. You may be able to present the information more rapidly than the child. If time is not a factor, then you may want to choose an active response. Active responses insure that the child has attended to the relevant characteristics of the stimuli and generally increases the effectiveness of instruction.

In addition to determining the response of the child, when teaching more than one student you must decide whether only the student receiving the trial will respond or whether the entire group will respond to the extra information presented in each trial. The options were reviewed in earlier in the manual.

How will learning be monitored?

After each of the decisions listed above have been made, you must decide how acquisition of the non-target information will be assessed. In all of the research on adding non-target information into the attending cues and responses, the extra information was assessed before the instruction began and after children met criterion on the behaviors being taught directly. Another alternative is to assess children's acquisition of the information on a daily or weekly basis. We do not know what effects more frequent assessments of the non-target information may have on the acquisition rates of that information; however, logic would suggest that it would be acquired more quickly.

Summary of Steps for Adding Non-Target Information to Attending Cues and Responses

To increase the likelihood that students will learn extra, non-target behaviors that are inserted into the attending cues and/or attending responses, you must make several decisions. These are:

- What extra information will be presented,
- how many different pieces of information will be presented,
- on which trials will the information be presented,
- in what mode will the information be presented,
- what child response is expected, and
- how the information will be assessed.

Many of these decisions must be made on the basis of teachers' judgements, although some of the research provides suggestions on how to do it. Self-Test # 3 is presented on the next page.

Self-Test # 3: Questions

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1. What are the two major ways that manipulating the attending cues and attending responses can increase the efficiency of learning?

2. What general guideline about the use of attending cues and responses should be followed when children are not making adequate progress on target behaviors?

3. What are some steps of teachers must address when planning to add non-target information to attending cues and responses?

Answers are provided on the next page

Answers to Self-Test # 3

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1. Manipulating the attending cues and attending responses can increase the efficiency by
   (a) helping children focus more directly on the critical aspects of the target stimulus, and
   (b) adding extra, non-target information to the attending cues and/or the attending responses.

2. When children are not making adequate progress on target behaviors, teachers should "use specific attending cues and active attending responses that demonstrate clearly that the student is attending to the critical aspects of the stimulus."

3. The steps teachers must address when planning to add non-target information to attending cues and responses are: (a) deciding what extra information will be presented, (b) deciding how many different pieces of information will be presented, (c) deciding on which trials the extra information will be presented, (d) deciding in what mode will the information be presented, (e) decided what the child's attending response will be, and (f) deciding how to monitor the students' learning.

Research Related to Extra Information in the Antecedent Event

In this section, the reader is provided with summaries of the research related to adding non-target information to the attending cues and responses of direct instructional trials to increase the efficiency of that instruction. A complete reference of each study is presented in Appendix A. Each of the eight research studies that added extra information to the antecedent event are described below. These descriptions identify the target behaviors, extra information, instructional strategy, and a description of how the extra information was presented.

Alig-Cybriwsky et al. (1990) assessed the use of a constant time delay procedure in teaching four preschoolers with developmental delays in a small group arrangement to read sight words. The spelling of the target word was provided as extra information. A group attending cue was used in which the teacher pointed to and named the letters in the target word. The children repeated the letters as the teacher read. In this study all four preschool-aged children acquired all target sight words. Extra information, spelling, was assessed receptively prior to instruction for a group mean of 8.1%; following instruction the group mean was 70%.

Gast, Doyle, Wolery, Ault, and Baklarz (1991) used a small group arrangement and a constant time delay procedure to teach four elementary children with mild mental retardation to read sight words. Spelling of the words was provided as extra information. Prior to each presentation of the target word, the teacher instructed the student receiving the trial to look and then she spelled the letters in the target word. No response was required from the students. Each child learned their twelve target words. The mean percent of correct spelling was 68.8% with a range of 50% to 100% across the four children.

Gast et al. (1988) taught four elementary-aged students with moderate mental retardation in a 1:1 instructional arrangement to name sight words of foods. In this study a constant time delay procedure was compared to the system of least prompts. No extra information was provided during constant time delay instruction. The prompt levels in the system of least prompts instruction included a verbal description of the classification categories of the target food words. For example, if the sight word was broccoli, one of the verbal prompts was "It is a vegetable." Children acquired all behaviors instructed with both the constant time delay procedure and the system of least prompts; however, the constant time delay procedure resulted in more efficient learning (i.e. number of sessions, percent of errors, and direct instruction time through criterion).

Keel and Gast (1992) studied the implementation of a constant time delay procedure with three elementary students with learning disabilities. Students were instructed in a small group arrangement to read basal vocabulary words with spelling provided as the extra information. Prior to all instructional trials, all students were required to copy a written model of the target word. If a student copied a word incorrectly, he was required to write the word again while the teacher read the letters. Children in this study acquired all target words. Percent of acquisition of extra information, spelling, was low. Three sets of words were instructed. Although children were able to spell some of the words in each set after each instruction; however, the ability to spell these words did not maintain. After instruction was completed on all word sets, one child correctly spelled 33% of the words and two children did not correctly spell any of the words.

Shelton, Gast, Wolery, and Winterling (1991) investigated the use of a progressive time delay procedure in teaching two small groups of four children each to read sight words presented on a flash card. Children participating in this study ranged in age from 9 to 12 years and had mild mental retardation. Naming the letters of the target word in order was presented as the extra information. When it was a given student's turn to receive a trial, he was presented with the attention cue, "Spell the word." If the student spelled the word correctly, the teacher repeated the spelling. When the word was spelled incorrectly, the teacher pointed to the letter and modelled the appropriate letter name and then pointed in sequence to each letter in the word and modelled while the student repeated. Children in this study acquired all target behaviors. Extra information in the antecedent event, spelling, was not acquired be one child. Of the remaining seven children, rates of acquisition of correct spelling ranged from 17% to 100% with a mean of 46%.

Winterling (1990) used a constant time delay procedure to teach sight word reading to three elementary students with learning disabilities. Two students were required to copy a written model of the target word prior to reading that word and one student was required to orally name the letter in the word, thus embedding written spelling as the extra information in the antecedent event. The three children in this study learned to read all target sight words. One child learned to orally spell all of his target words, one child learned to write 66% of her target words, and the remaining child did not learn to write any of his target words.

Wolery, Ault, Gast, Doyle, and Mills (1990) taught four elementary student with learning disabilities to read sight words using a constant time delay procedure. The authors investigated the use of two different ways of presenting the extra information. Half of each student's sight words were taught using a group attentional response. A group attentional response required all students to name the letters of the target word in correct order following the teacher's verbal model. After all students named the letters in the target word, the target student read the word. The remaining sight words were taught using a individual attentional response. Only the student who was receiving a trial on the sight word was required to imitate the teacher's verbal model of the correct spelling of the target word. Children acquired all target behaviors; however, those instructed with an individual attentional response were acquired more efficiently (i.e. number of sessions and number/percent of errors through criterion) than those instructed with a group attentional response. In this study the mean percentage of net gain of spelling was 26 with a range of 7 to 49.

Yancey (1987) used a constant time delay procedure in a 1:1 instructional format to teach sight word reading to five elementary students with mild handicaps. Students were required to say the letters in the target word prior to reading the word. If a child incorrectly read a word, he was instructed to read the letters again. As in the previous studies, children acquired all target words. One child learned to spell 10%, one child learned to spell 60%, and the remaining three children learned to spell 95% to 100% of the extra information.

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Appendix A

Alig-Cybriwsky, C., Wolery, M., & Gast, D. L. (1990). Use of a constant time delay procedure in teaching preschoolers in a group format. Journal of Early Intervention, 14, 99-116.

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Appendix C

Instructional Module

(Module for dissemination is spiral bound)

Instructional Module:

Promoting the Efficiency of Direct Instruction by Adding Non-Target Stimuli to Trial Sequences

Mark Wolery

1992

Learning Efficiently: Acquisition of Related Non-Target Behaviors

Project LEARN

Early Childhood Intervention Program
Department of Psychiatry
Allegheny-Singer Research Institute
320 E. North Avenue
Pittsburgh, PA 15212

Instructional Module:

Promoting the Efficiency of Direct Instruction by Adding Non-Target Stimuli to Trial Sequences

Mark Wolery

1992

Purpose of the Module

This Instructional Module describes procedures for training prospective and practicing teachers to use two strategies for enhancing the efficiency of instruction; these are: (a) manipulating attending cues and responses, and (b) using instructive feedback. The Instructional Module is designed for use by faculty members in teacher preparation programs and for use by instructors of inservice training programs. Our intent is to disseminate the information from our research to as many individuals as possible; therefore, we give permission for users to reproduce the document and to use it, in whole or in part, in their own training and research activities. We request, however, that any reproductions contain the acknowledgement and disclaimer that the module was developed by the a grant (Project LEARN, Grant Number H023C00125) from the U.S. Department of Education.

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Description of the Module

This module contains several sections:

- (a) competencies to be acquired,
- (b) rationale for the competencies,
- (c) objectives,
- (d) prerequisites for learners,
- (e) evaluation criteria,
- (f) suggested learning activities, and
- (g) content outline for training sessions.

It is designed to train students to manipulate attending cues and attending responses and to use instructive feedback. However, training could be provided for either manipulation (i.e., attending cues/responses or instructive feedback) using the module. Two manuals accompany this module, and the module is prepared with the assumption that learners will have access to the manuals. These manuals are available from the authors.

Holcombe-Ligon, A., Wolery, M., & Werts, M. G. (1992). Using attending cues to increase the efficiency of direct instruction. (U.S. Department of Education, Grant No. H023C00125). Unpublished training manual. Allegheny-Singer Research Institute, 320 E. North Avenue, Pittsburgh, PA 15212.

Werts, M. G., Wolery, M., & Holcombe, A. (1991). Instructive feedback: Increasing opportunities for learning through the addition of incidental information. (U.S. Department of Education, Grant No. H023C00125). Unpublished training manual. Allegheny-Singer Research Institute, 320 E. North Avenue, Pittsburgh, PA 15212.

Instructional Module:

Promoting the Efficiency of Direct Instruction by Adding Non-Target Stimuli to Trial Sequences

COMPETENCIES TO BE ACQUIRED

1. Learners will describe basic components of direct instruction.
2. Learners will describe the steps for using attending cues and attending responses to increase the efficiency of direct instruction.
3. Learners will describe the steps for using instructive feedback.
4. Learners will use attending cues and/or responses and instructive feedback to teach a student two target and non-target behaviors.

RATIONALE FOR COMPETENCIES

Substantial research indicates that the use of instructive feedback and manipulations of attending cues and responses can result in children acquiring both the behaviors targeted for direct instruction and the non-target stimuli that are presented by not taught directly. For instructive feedback, this finding occurs across learners with number of different disabilities and age ranges. Less research exists supporting the manipulations of attending cues and responses; however, for elementary-aged children with learning disabilities and mild mental retardation, the manipulations of the attending cues and responses have been quite effective.

OBJECTIVES

1. To describe the components of direct instruction.
2. To define attending cues and attending responses

3. To describe a classification system of attending cues and attending responses.

4. To describe the steps for using attending cues/responses for increasing the efficiency of direct instruction.

5. To define instructive feedback.

6. To describe the steps for using instructive feedback to increase the efficiency of instruction.

LEARNER PREREQUISITES

Learners should have knowledge and performance competencies related to systematic and direct instruction.

EVALUATION PROCEDURES AND CRITERIA

The instructor should develop their own evaluation procedures and criteria; however, within the manuals are self-tests of the content.

LEARNING ACTIVITIES AND ALTERNATIVES

1. Learners should read and complete the self-tests of the two accompanying manuals. These are:

   Holcombe-Ligon, A., Wolery, M., & Werts, M. G. (1992). Using attending cues to increase the efficiency of direct instruction. (U.S. Department of Education, Grant No. H023C00125). Unpublished training manual. Allegheny-Singer Research Institute, 320 E. North Avenue, Pittsburgh, PA 15212.

   Werts, M. G., Wolery, M., & Holcombe, A. (1991). Instructive feedback: Increasing opportunities for learning through the addition of incidental information. (U.S. Department of Education, Grant No. H023C00125). Unpublished training manual. Allegheny-Singer Research Institute, 320 E. North Avenue, Pittsburgh, PA 15212.

2. Learners should read the following articles that used manipulations of the attending cues and/or attending responses.

Preschool Children with Developmental Delays:

Alig-Cybriwsky, C., Wolery, M., & Gast, D. L. (1990). Use of a constant time delay procedure in teaching preschoolers in a group format. Journal of Early Intervention, 14, 99-116.

Elementary-Aged Children with Mild Disabilities

Gast, D. L., Doyle, P. M., Wolery, M., Ault, M. J., & Baklarz, J. L. (1991). Acquisition of incidental information during small group instruction. Education and Treatment of Children, 14, 1-18.

Keel, M., & Gast, D. L. (1992). Small group instruction for students with learning disabilities: A study of observational and incidental learning. Exceptional Children, 58, 357-368.

Shelton, B., Gast, D. L., Wolery, M., & Winterling, V. (1991). The role of small group instruction in facilitating observational and incidental learning. Language, Speech, and Hearing Services in Schools, 22, 123-133.

Winterling, V. (1990). The effects of constant time delay, practice in writing or spelling, and reinforcement on sight word recognition in a small group. Journal of Special Education, 24, 101-116.

Wolery, M., Ault, M. J., Gast, D. L., Doyle, P. M., & Mills, B. M. (1990). Use of choral and individual attentional responses with constant time delay when teaching sight word reading. Remedial and Special Education, 11, 47-58.

3. Learners should read the following articles that used instructive feedback.

General Issues with Instructive Feedback

Werts, M. G., Wolery, M., Gast, D. L., & Holcombe-Ligon, A. (1992). Instructive feedback: Increasing opportunities for additional learning. Manuscript submitted for publication. Allegheny-Singer Research Institute, Pittsburgh, PA.

Preschool Children with Developmental Delays:

Werts, M. G., Wolery, M., Holcombe-Ligon, A., Vassilaros, M. A., Billings, S. S. (in press). Efficacy of transition-based teaching with instructive feedback. Education and Treatment of Children.

Wolery, M., Holcombe, A., Werts, M. G., & Cipolloni, R. M. (in press). Effects of simultaneous prompting and instructive feedback. Early Education and Development.

Wolery, M., Werts, M. G., Holcombe, A., Billings, S. S., Vassilaros, M. A. (in press). Comparison of simultaneous and alternating presentation of non-target information. Journal of Behavioral Education.

Elementary-Aged Children with Mild Disabilities

Gast, D. L., Doyle, P. M., Wolery, M., Ault, M. J., & Baklarz, J. L. (1991). Acquisition of incidental information during small group instruction. Education and Treatment of Children, 14, 1-18.

Shelton, B., Gast, D. L., Wolery, M., & Winterling, V. (1991). The role of small group instruction in facilitating observational and incidental learning. Language, Speech, and Hearing Services in Schools, 22, 123-133.

Elementary-Aged Children with Moderate Mental Retardation

Gast, D. L., Wolery, M., Morris, L. L., Doyle, P. M., & Meyer, S. (1990). Teaching sight word reading in a group instructional arrangement using constant time delay. Exceptionality, 1, 81-96.

Stinson, D. M., Gast, D. L., Wolery, M., & Collins, B. C. (1991). Acquisition of nontarget information during small-group instruction. Exceptionality, 2, 65-80

Wolery, M., Doyle, P. M., Ault, M. J., Gast, D. L., Meyer, S., & Stinson, D. (1991). Effects of presenting incidental information in consequent events on future learning. Journal of Behavioral Education, 1, 79-104.

Secondary-Aged Children with Mild Disabilities

Wolery, M., Cybriwsky, C. A., Gast, D.L., & Boyle-Gast, K. (1991). Use of constant time delay and attentional responses with adolescents. Exceptional Children, 57, 462-474.

Secondary-Aged Children with Moderate Mental Retardation

Doyle, P. M., Gast, D. L., Wolery, M., Ault, M. J., & Farmer, J. A. (1990). Use of constant time delay in small group instruction: A study of observational and incidental learning. Journal of Special Education, 23, 369-385.

Gast, D. L., Doyle, P. M., Wolery, M., Ault, M. J., Farmer, J. A. (1991). Assessing the acquisition of incidental information by secondary-age students with mental retardation: A comparison of response prompting strategies. American Journal on Mental Retardation, 96, 64-80.

4. View a video tape that describes and illustrates the use of manipulations of attending cues/responses and the use of instructive feedback.

5. Observe a teacher of children with disabilities implement direct instructional sessions.

    5.1 During the observation, outline the trial sequence used including specification of
        (a) attending cues,
        (b) attending responses,
        (c) task direction,
        (d) response interval,
        (e) prompts used, and
        (f) nature and type of feedback provided.

    5.2 During an observation, collect data on the teacher's use of each component of the trial sequence; including:
        (a) attending cues,
        (b) attending responses,
        (c) task direction,
        (d) response interval,
        (e) prompts used, and
        (f) nature and type of feedback provided.

6. Write an instructional program plan that uses each of the following types of attending cues/responses:
    (a) general attending cue with an active attending response
    (b) general attending cue with an inactive attending response
    (c) specific attending cue with an active attending response
    (d) specific attending cue with an inactive attending response

7. Under supervision from a trained person, implement direct instructional sessions using each of the following types of attending cues:
   - (a) a general attending cue implemented on every trial with each trial using the same attending cue,
   - (b) a general attending cue implemented on every trial with at least two attending cues implemented on alternating trials,
   - (c) a specific attending cue implemented on every trial with each trial using the same attending cue, and
   - (d) a specific attending cue implemented on every trial with at least two attending cues implemented on alternating trials.

8. Under supervision from a trained person, implement direct instructional sessions using each of the following types of attending responses:
   - (a) an inactive attending response for individual children implemented on every trial,
   - (b) an active attending responses for individual children implemented on every trial,
   - (c) an inactive attending response for a group of children implemented on every trial, and
   - (d) an active attending response for a group of children implemented on every trial.

9. Write an instructional program plan that uses each of the following types of instructive feedback:
   - (a) parallel,
   - (b) expansion, and
   - (c) novel.

10. Under supervision from a trained person, implement direct instructional sessions using each of the following types of instructive feedback:
    - (a) parallel,
    - (b) expansion, and
    - (c) novel.

CONTENT OUTLINE

This content outline relies heavily on information presented in the two instructional manuals that accompany this module.

1.0 Introduction to Direct Instruction

  1.1 Components of direct instruction

    1.1.1 Teachers have identified some important behaviors that their students should be taught

      -- Describe discrete behaviors

      -- Describe response chains

    1.1.2 Direct instructional sessions are often relatively short

    1.1.3 Direct instructional activities involve use of a defined trial sequence

      -- Describe common elements of trial sequences

        ** securing students' attention
        ** presenting the target stimulus
        ** providing an opportunity to respond
        ** providing and fading prompts (assistance)
        ** delivering contingent feedback

      -- Describe variations of the elements of the trial sequence

    1.1.4 Direct instructional activities involve active student responding

  1.2 Evaluating the effects of direct instruction

    1.2.1 Evaluating the effectiveness of direct instruction

      -- Define "effectiveness": children learn the behaviors that are taught

      -- Discuss measures for evaluating the effectiveness of instruction for different types of behaviors and different types of responses

1.2.2 Evaluating the efficiency of direct instruction

-- Define "efficiency":

** Efficient instruction is effective (i.e., results in children acquiring the targeted behaviors)

** Efficiency refers to some relative value of one instructional strategy or practice over another (i.e., results in superior learning)

-- Discuss means for measuring the relative value (superiority) of one strategy over another

** Rapidity of learning measured by the number of sessions, number of trials, number of minutes of instruction to criterion, and the number and percentage of errors to criterion

** Breadth of learning measured by the number of target and non-target behaviors that are acquired during instruction

oo target behaviors are those that are taught directly
oo non-target behaviors are those that are presented but not taught directly and assumed to be learned from observational and/or incidental learning processes

2.0 Using Attending Cues and Attending Responses to Increase the Efficiency of Direct Instruction

2.1 Define attending cues and attending responses

2.1.1 Attending cues are the behaviors teachers do to get children to orient toward and focus on the target stimulus

2.1.2 Attending responses are the behaviors children do in response to attending cues that indicate they are ready to respond

2.2 Describe classification of attending cues and attending responses using the taxonomy presented on the next page

Taxonomy of Attending Cues/Responses

Presentation Variables	Response Variables			
Type Across Trials Nature of Cue	Individual		Group	
	Active	Inactive	Active	Inactive
Same for Each Trial				
General	On each trial the teacher says, "Look" & only the target student must look at the stimulus	On each trial the teacher says, "Time to work" & no response is required of any student	On each trial the teacher says, "Look" & all of the students must look at the stimulus	On each trial the teacher says, "Time to work" & no response is required of any student
Specific	On each trial the teacher says, "Name the letters" & only the target student names the letters	On each trial the teacher says, "Look" to the target student & the teacher names the letters	On each trial the teacher says, "Name the letters" & all group members name the letters	On each trial the teacher says, "Look" to the group and the teacher names the letters for the group
Different Across Trails				
General	Across different trials, the teacher says, "Look," "Touch," "Hold," or "Listen" (1 per trial); & only the target student must comply with the cue	Across different trials the teacher says, "Time to work," "Let's start," "I'm ready" (1 per trial); and no response is required of any student	Across different trials the teacher says "Look," "Touch," "Hold" or "Listen" (1 per trial); & all students must comply with the cue	Across different trials the teacher says, "Time to work," "Let's start," "I'm ready" (1 per trial); & all students must comply with the cue
Specific	Across different trials, the teacher says, "Name the letters," "Match," or "Trace these" (1 per trial); & only the target student must comply with the cue	Across different trials the teacher says, "Look" or "Listen" to the target student & the teacher names, matches, or traces the stimuli (1 per trial; no response required of student	Across different trials the teacher says "Name the letters," "Match," or "Trace these" (1 per trial) & all students must comply with the cue	Across different trials the teacher says, "Look" or "Listen" to group & teacher names, matches, or traces stimuli (1 per trial) for all students; no response is required of any student

2.3 Describe questions to be asked when selecting attending cues and responses

  2.3.1 Will I use the same attending cue on each trial?

  2.3.2 What type of attending cue (general or specific) will be used?

  2.3.3 Will I require students to respond individually or as a group?

  2.3.4 Will I require students to respond actively or inactively?

2.4 General guidelines for selecting attending cues and attending responses

  2.4.1 Use the quickest and easiest attending cue and response necessary to ensure that students orient toward the target stimulus

  2.4.2 With children who are not making progress, use specific attending cues and active attending responses that demonstrate clearly that the student is attending to the critical aspects of the stimulus

2.5 Steps for adding extra, non-target stimuli to the attending cues and/or attending responses

  2.5.1 Deciding what extra, non-target (incidental) stimuli (information, content) will be added to the attending cue and/or attending response

  2.5.2 Deciding whether one or two or more "pieces" of information will be added to the attending cues/responses

  2.5.3 Deciding on which trials (all, intermittent, alternating, etc.) the extra, non-target stimuli will be presented in the attending cues/responses

  2.5.4 Deciding on the mode (visual, verbal, visual and verbal, other) through which the extra, non-target stimuli will be presented in the attending cues/responses

  2.5.5 Determining what response to the attending cue will be expected from the students

  2.5.6 Deciding how the students' acquisition of the extra, non-target stimuli will be monitored and assessed

3.0 Using Instructive Feedback to Increase the Efficiency of Instruction

3.1 Define Instructive Feedback

3.1.1 Instructive feedback is the presentation of extra, non-target behaviors during consequent events for students' responses to target behaviors

3.1.2 Students are not expected to respond to the presentation of the instructive feedback stimuli

3.1.3 Students are not reinforced if they do respond to the presentation of the instructive feedback stimuli

3.2 Describe the three types of instructive feedback

3.2.1 Expansion instructive feedback involves presenting a stimulus that is from the same curricular domain as the target behavior and is conceptually related to the target behavior

3.2.2 Parallel instructive feedback involves presenting a stimulus that has the same response as the target stimulus

3.2.3 Novel instructive feedback involves presenting a stimulus that is not from the same curricular domain as the target stimulus and is not conceptually related to it

3.3 Steps for using instructive feedback to increase the efficiency of direct instruction

3.3.1 Identify the behaviors that the student needs to learn, select an instructional technique, and select a time and format for teaching

3.3.2 Select the stimuli (extra, non-target information) that will be presented through instructive feedback

3.3.3 Determine how the target stimuli will be presented

3.3.4 Determine how and when the instructive feedback stimuli (extra, non-target stimuli) will be presented

3.3.5 Determine how the students are expected to respond to the target stimuli

3.3.6 Determine what responses are expected, if any, from the student to the instructive feedback stimuli

3.3.7 Determine how acquisition of the target behaviors will be monitored

3.3.8 Determine how acquisition of the instructive feedback behaviors will be monitored

3.3.9 Decide how to adjust instruction if students do not acquire the behaviors being taught directly and indirectly

4.0 Describe the findings from research where attending cues/attending responses and instructive feedback has been used

4.1 Findings from the manipulation of the attending cues/attending responses

4.1.1 During direct instruction, if children (a) are not acquiring the target behaviors, (b) the target behaviors are within the range of appropriate skills (i.e., the children have the prerequisites for the skill), and (c) reinforcers are being used, then use of specific attending cues and active attending responses that provides additional information and focuses attention on the distinctive features of the target stimulus may result in children acquiring the target behaviors and in some cases acquisition of the non-target stimulus

4.1.2 When teaching sight word reading to preschool and elementary-age children, having them (a) repeat the letters of the words after the teacher names them but before the teacher asks them to read the word, (c) say the letters of the word without a teacher model before the teacher asks them to read the word, and (d) writing the letters in order from a visual model before being asked to read the word will result in students learning to spell the words as well as read the words

4.1.3 Active attentional responses (e.g., writing a word before reading it) as compared to inactive responses (e.g., watching the teacher write it) may result in more acquisition of the additional stimuli (i.e., spelling), but also results in longer instructional sessions

4.1.4 The addition of extra, related, non-target stimuli in the antecedent portion of trials may interfere with acquisition of the target response when children do not have a history of direct instruction

4.2 Findings from the use of instructive feedback

4.2.1 When instructive feedback has been used (a) with response prompting strategies, (b) in direct instruction, (c) with identified reinforcers, (d) with multiple target behaviors being taught simultaneously, (e) with delivery of the instructive feedback following each correct child response, (f) with only pre- and posttest assessment, and (g) with consistent and static presentation of the instructive feedback stimuli, then students acquire some, if not all, of the instructive feedback stimuli

4.2.2 This finding (i.e., 4.1.1. above) has occurred for (a) preschoolers with developmental delays, moderate mental retardation, and hearing impairments; (b) elementary-aged children with learning disabilities, behavior disorders, mild mental retardation, and moderate mental retardation; and (c) adolescents with moderate mental retardation and behavior disorders

4.2.3 The types of behaviors taught in the instructive feedback studies are presented below; as shown, a range of behaviors have been successfully acquired

Target	Instructive Feedback
Naming number sets	Naming numerals
Naming numerals	Reading number words
Naming coin values	Number words, numerals
Matching factions	Matching equivalent fractions
Naming photographs	Reading words
Reading words	Stating a definition
Reading words	Spelling those words
Stating facts	Stating related facts
Naming photographs	Stating information about photos
Naming shapes	Stating color of shapes
Identification of Rebus symbols	Classification of symbols
Stating antonyms	Reading word, definitions

4.2.4 Acquisition of instructive feedback stimuli has occurred in a variety of instructional arrangements, including (a) one-to-one instruction, (b) small group instruction (3-5 students), (c) transition-based teaching, and (d) computer-assisted instruction

4.2.5 Teachers of preschool, elementary, and secondary students have implemented the instructive feedback procedure correctly during direct instructional sessions, and teachers of preschool children have implemented it reliably in transition-based teaching arrangements

4.2.6 Instructive feedback stimuli have been presented verbally (i.e., teacher says it), visually (i.e., on cards or photographs), verbally and visually (teachers says it while showing a card/picture), and verbally and through manual sign (i.e., through total communication)

4.2.7 Instructive feedback stimuli have been acquired (a) when one instructive feedback stimulus is presented for each target behavior; (b) when two instructive feedback stimuli are presented for each target behavior either simultaneously on each trial or separately on alternating trials (however, the difficulty and whether children have a referent for the instructive feedback stimuli may influence the occurrence and amount of acquisition); and (c) when the instructive feedback stimuli are related (within the same curricular domain) or unrelated (in a different curricular domain) to the target stimuli

4.2.8 When the instructive feedback stimuli involve behavior that will taught directly in the future (i.e., parallel instructive feedback stimuli), students learn the "future" target behaviors that were presented through instructive feedback more rapidly than similar target behaviors that were not presented through instructive feedback; however, all studies of this issue have involved the same response to various forms of the stimulus)

4.2.9 Use of instructive feedback does not appear to interfere with the rapidity with which target behaviors are acquired, or to increase substantially the length of instructional sessions

4.2.10 In small group instruction, students sometimes acquire a portion of their peers' target and instructive feedback stimuli

4.2.11 Use of specific attending cues (e.g., asking children to repeat the task direction) as compared to general attending cues (e.g., asking them to look at the target stimulus) appears to increase the probability of students learning their peers' instructive feedback stimuli

4.2.12 When instructive feedback is structured such that equivalent relationships can be established and tested, stimulus classes are sometimes formed -- particularly, if the instructive feedback stimuli are less complex or less difficult than the target stimuli

5.0 Recommendations for Use of Manipulations of the Attending Cues/Responses and Instructive Feedback

5.1 Both manipulations of attending cues/responses and instructive feedback should be used in the context of direct instruction

5.2 Use of manipulations of attending cues/responses and instructive feedback should be planned carefully

5.3 Manipulations of the attending cues/responses should be used when students are not making adequate progress, but reinforcers have been identified and used, the skills being taught are appropriate, the instructional strategy being used has been effective with similar students and skills, and the instructional strategy is being used correctly

5.4 Manipulations of the attending cues/responses should be monitored carefully to ensure that they do not increase session length substantially and do not interfere with acquisition of the target behaviors

5.5 Instructive feedback has been used with such wide variety of learners, skills, and instructional arrangements and as a result, teachers are encouraged to employ it throughout their direct instructional activities

Appendix D

Triadic Instruction of Chained Food Preparation Responses: Acquisition and Observational Learning

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TRIADIC INSTRUCTION OF CHAINED FOOD PREPARATION RESPONSES: ACQUISITION AND OBSERVATIONAL LEARNING

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This research examined whether constant time delay would be effective in teaching students with moderate mental retardation in triads to perform chained tasks and whether observational learning would occur. Three chained snack preparation tasks were identified, and each student was directly taught one task. The other 2 students observed the instruction. The instructed student told the observers to watch and to turn pages of a pictorial recipe book. The teacher provided frequent praise to the instructed student based on performance and to the observers for watching the instruction and turning pages. A multiple probe design across students and tasks was used to evaluate the instruction. The results indicated that each student learned the skill he or she was taught directly, and the observers learned nearly all of the steps of the chains they observed. The implications for classroom instruction and future research in observational learning are discussed.

DESCRIPTORS: chained tasks, constant time delay, food/snack preparation, mentally retarded, observational learning

The curriculum for students with moderate mental retardation should focus on skills that increase their independence in community living (Snell, 1987; Wolery, Ault, & Doyle, 1992). Examples of these skills include dressing and undressing, janitorial skills, purchasing goods and services in the community, and using public transportation. Cooking skills and snack preparation are critical skills for independent living and may lead to vocational opportunities (Schuster, 1988). Many of these skills are chained tasks requiring performance of a number of separate behaviors sequenced together to form a complex skill.

Current instructional practices suggest that chained tasks should be taught using a total-task presentation format within naturally occurring routines (Kayser, Billingsley, & Neel, 1986). The system of least prompts (increasing assistance) traditionally has been used to teach response chains (Doyle, Wolery, Ault, & Gast, 1988). The system of least prompts uses a hierarchy of prompts ordered from the least to most intrusive. On each trial, the student is presented with an opportunity to perform without prompts; if no response or an error occurs, the student is presented with the least intrusive prompt and a response interval; again, if no response or an error occurs, the student is presented with the next level of prompt and a response interval; this process continues until a correct response occurs.

The constant time delay procedure also has been

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used to teach skills to students with mental retardation. The constant time delay uses one controlling prompt delivered initially in 0-s delay trials (i.e., immediately after the presentation of the discriminative stimulus); in subsequent trials, the prompt is withheld for a fixed and specified length of time after delivery of the discriminative stimulus. Schuster, Gast, Wolery, and Guiltinan (1988) used constant time delay in a one-to-one arrangement to teach 4 students with moderate mental retardation three chained cooking skills. McDonnell (1987) compared constant time delay and the system of least prompts in one-to-one instruction in teaching chained tasks to students with severe mental retardation. Both procedures were effective, but constant time delay was more efficient. Similarly, Wolery, Ault, Gast, Doyle, and Griffen (1990) compared constant time delay and the system of least prompts in one-to-one instruction in teaching chained tasks to students with moderate mental retardation. As in McDonnell's study, both procedures were effective, but constant time delay resulted in more rapid learning.

Although the results of these studies are encouraging, the use of one-to-one instruction presents logistical problems for classroom teachers. Research with discrete tasks indicates that many students with moderate mental retardation can learn in small-group instruction (Collins, Gast, Ault, & Wolery, 1991). In addition to solving logistical problems and saving time for teachers, small-group instruction provides an opportunity for observational learning (i.e., students can learn skills taught to other students).

Recently, investigators have attempted to teach chained tasks in small-group contexts, specifically in dyads. Schoen, Lentz, and Suppa (1988) compared decreasing assistance and graduated guidance in teaching children face washing and fountain drinking. One child in the dyad was taught the chain and the other member observed the instruction. The teacher cued the observer to watch the instruction and provided reinforcement for watching. Both prompting procedures were effective, and the observer also learned the skills. Schoen and Sivil (1989) compared time delay and the system of least prompts in teaching children to get a drink and make a snack. As in the Schoen et al. study, 1 child was taught the chains while the other child observed. The observer was instructed by the teacher to watch the instruction and was reinforced for doing so. Both procedures were effective, but time delay was more efficient. Interestingly, the observer also learned many components of the task. Wolery, Ault, Gast, Doyle, and Griffen (1991) taught students with moderate mental retardation chained tasks in dyads using constant time delay. However, unlike the studies by Schoen et al. and Schoen and Sivil, each student was taught half the skill and observed the other half. Also, the teacher did not cue or reinforce observation; however, she prompted the instructed student to cue the observer at the beginning of the chain to watch. Programmed contingencies for observing were not in effect. Students learned their portions of the response chain and learned substantial portions of the chain they observed.

The purpose of this investigation was two-fold. First, the study sought to determine whether constant time delay would be effective in teaching chained tasks in triads. Second, the study focused on whether observational learning would occur when 2 students served as observers and did not receive direct instruction.

METHOD

Participants and Setting

The participants in this study were 3 students (1 male, 2 female) with moderate mental retardation. They were enrolled in a self-contained classroom in an elementary school (grades K–6). All students were diagnosed as having Down syndrome. Colin (age 13 years, 8 months) wore a hearing aid to correct a unilateral moderate hearing loss. Testing with the Stanford-Binet Intelligence Scale (Terman & Merrill, 1973) yielded an IQ score of 33 and a mental age of 3 years, 1 month. Colin spoke in two- to three-word phrases, but articulation errors affected speech intelligibility. Colin read some food words, sorted laundry, and wrote job application information, but was unable to count change, tie shoes, or determine which item cost less. Alma (age 12 years, 8 months) received an IQ score of 42 and a mental age of 4 years, 4 months on the Stanford-Binet. Alma spoke in two- to five-word phrases. She could read most food and recipe direction words and identified all coins and coin values, read monetary amounts to $100.00, and used dollar bills to purchase items totaling less than $20. Alma could read Dolch words at the second- and third-grade level and could set a table, but was unable to tie shoes, pack a suitcase, or use a can opener. Andrea (age 10 years, 11 months) had an IQ score of 37 and a mental age of 3 years, 8 months on the Stanford-Binet. Andrea could write her name and address, read some food and recipe direction words, and wash dishes, but could not count varying monetary amounts or tell time in 5-min intervals.

All of the students demonstrated mastery of the prerequisite skills necessary for learning the chained tasks. These included adequate visual acuity to see the stimulus materials, auditory acuity, ability to imitate simple motor movements, volitional motor control, ability to stay on task for 15 to 20 min in a group setting, ability to wait for a prompt, and the ability to choose a reinforcer. All students could receptively identify all materials used in the response chains taught in this study. Prerequisite skills were assessed during instructional activities. The ability to stay on task was observed for a variety of activities, and the ability to select a reinforcer was assessed with a reinforcement menu. Students demonstrated a consistent wait response in discrete-trial group settings (e.g., reading tasks) as well as individual chained-task settings (e.g., setting the table). Volitional motor control and imitating motor movements were assessed through activities such as making Kool-Aid®, washing dishes, and folding clothes.

Sessions were conducted in the student's classroom (6.4 m by 8.8 m) by the classroom teacher. Materials were placed on a rectangular table (1.5 m by 0.7 m) and on shelves (0.9 m by 2.4 m) at one end of the table. A small refrigerator and garbage can were placed at the end of the table near the shelves. Three dishpans and a dish drainer placed on two student desks were used for washing, rinsing, and draining dishes. Appliances needed (e.g., blender) were placed on the table. This work area was located in one corner of the classroom and was typically used for chained tasks such as setting the table, folding napkins, and snack preparation.

Chained Tasks and Materials

Three chained snack preparation tasks were selected for instruction: making a milkshake, scrambled eggs, and pudding. The task analyses and materials for each are shown in Table 1. Instant pudding mix was used to allow students to eat it immediately. A teacher-designed pictorial recipe was used with each skill. Each page of the recipe contained words describing the step, black-and-white line drawings illustrating the words, and the words "turn the page" with an arrow indicating the next page at the bottom right-hand corner. Multiple exemplars and distractors of all utensils, measuring cups, and bowls were always present to replicate a typical kitchen. Tokens from the classroom management system were used to reinforce students for participating in probe sessions, for the instructed student for completing the response chain during instructional sessions, and for the observing students for turning pages of the recipe book and watching the instruction. Back-up reinforcers included eating the prepared food (natural consequence of food preparation) or other small items usually available in the classroom.

Procedure

General procedures. A 5-s constant time delay (CTD) procedure was used in two daily single-trial sessions with a total task presentation to teach the chained responses. Criterion for each task was one session of 100% independent correct responses using a continuous reinforcement schedule (CRF), one session of 100% independent correct responses with an average of every two steps being reinforced (variable-ratio [VR] 2), one session of 100% independent correct responses using a VR schedule for one fourth of the task steps, and one session of 100% independent correct responses with reinforcement

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The teacher provided a model and verbal prompt. If the student responded correctly, the teacher confirmed the correctness of the response; if the student responded incorrectly, a physical prompt was provided.

Experimental Design

A multiple probe design across three chained tasks and 3 students was used to measure observational learning. Each of the students received instruction on one task while the other students observed. Probe conditions were implemented before instruction and after criterion performance was established on each task.

Reliability

Reliability data were collected on dependent measures and procedural fidelity (Billingsley, White, & Munson, 1980) at least twice during each experimental condition. A point-by-point method was used to calculate interobserver agreement percentages on dependent measures. Data were collected on the teacher's fidelity of implementing the following behaviors: (a) presenting the attentional cue, (b) having the materials ready, (c) providing the verbal cue, (d) waiting during the appropriate delay interval, (e) providing the correct prompt, (f) providing the correct consequence, and (g) providing verbal praise on the appropriate schedule. Procedural reliability was calculated by dividing the number of observed teacher behaviors in each category by the number of planned behaviors and multiplying by 100 (Billingsley et al., 1980).

Reliability observers included the third author, a full-time research associate, two other teachers who had participated in instructional research, and an undergraduate practicum student. All observers were experienced data collectors. They were given written and oral descriptions of the responses and definitions.

Reliability assessments occurred for 31.1% (milkshake), 32.1% (scrambled eggs), and 27.5% (pudding) of the probe sessions. Reliability assessments occurred for 55% (milkshake), 50% (scrambled eggs), and 60% (pudding) of the training sessions. During probes, the mean percentage of agreement on student responding during milkshake, scrambled eggs, and pudding sessions was 100% for Andrea and Alma; for Colin it was 100% for the milkshake and pudding tasks and 99.3% (range, 98% to 100%) for scrambled eggs. During training sessions, the mean percentage of agreement was 99% (range, 98% to 100%) for Alma (milkshake), 100% for Colin (scrambled eggs), and 99% (range, 98% to 100%) for Andrea (pudding).

Procedural reliability during probe sessions for all students was 100% for all teacher behaviors. Procedural reliability during training sessions for Alma (milkshake) was 100% for all behaviors except providing the appropriate prompt (99%, range, 98% to 100%) and providing verbal praise on the appropriate schedule (97.5%, range, 95% to 100%). For Colin (scrambled eggs), procedural reliability was 100% for all behaviors. For Andrea (pudding), procedural reliability was 100% for all behaviors except providing verbal praise on the appropriate schedule (97.5%, range, 95% to 100%) and providing appropriate consequences (99%, range, 98% to 100%).

RESULTS

Acquisition of Directly Trained Skills

The data for making milkshakes, scrambled eggs, and pudding are shown in Figures 1, 2, and 3, respectively. Probe data are graphed in two ways: (a) as the percentage of correct responses on all steps of the task analysis (including turning pages of the pictorial recipe books) and (b) as the percentage of correct responses on the critical steps of the task (excluding turning pages of the recipe books). Two responses are graphed for training conditions: correct anticipation responses and correct wait responses on all task steps.

Alma was directly taught to make a milkshake, and Colin and Andrea observed the instruction. Alma's percentage of correct responses for the last two sessions of Probe I on critical steps was 56% (Figure 1). Initiation of CTD training resulted in criterion level responding in 11 sessions. The mean session length was 15 min (range, 10.27 to 29.34).

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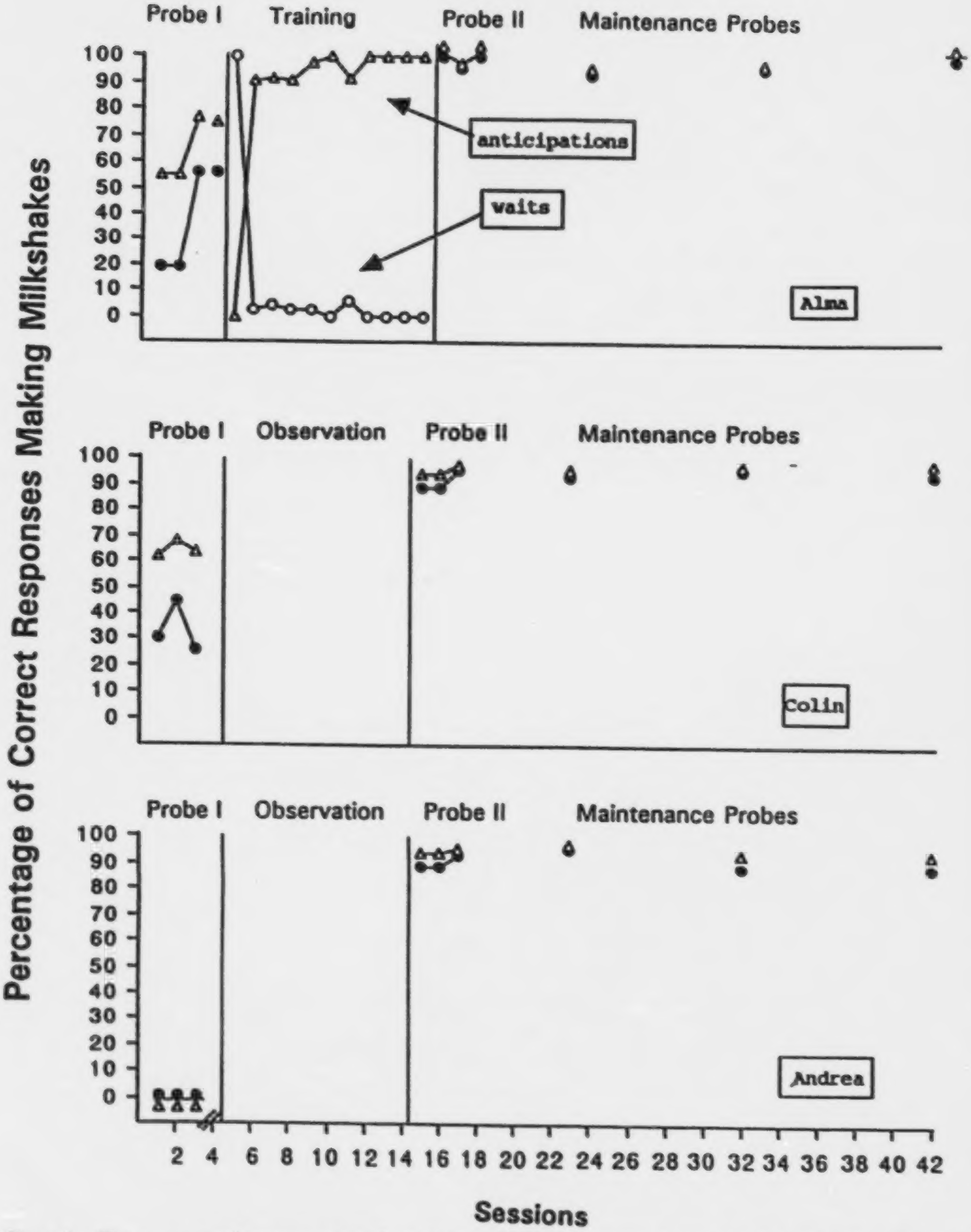

Figure 1. The percentage of correct responses for making a milkshake across experimental conditions for Alma (instructed student) is shown in the top graph; performance for Colin and Andrea (observing students) is shown in the middle and lower graphs, respectively. Scale breaks on the abscissa indicate absences of 1 to 7 days. Open triangles represent correct anticipations on all steps of the task analysis, closed circles represent correct anticipations on all steps excluding the page-turning steps, and open circles represent correct wait responses during training.

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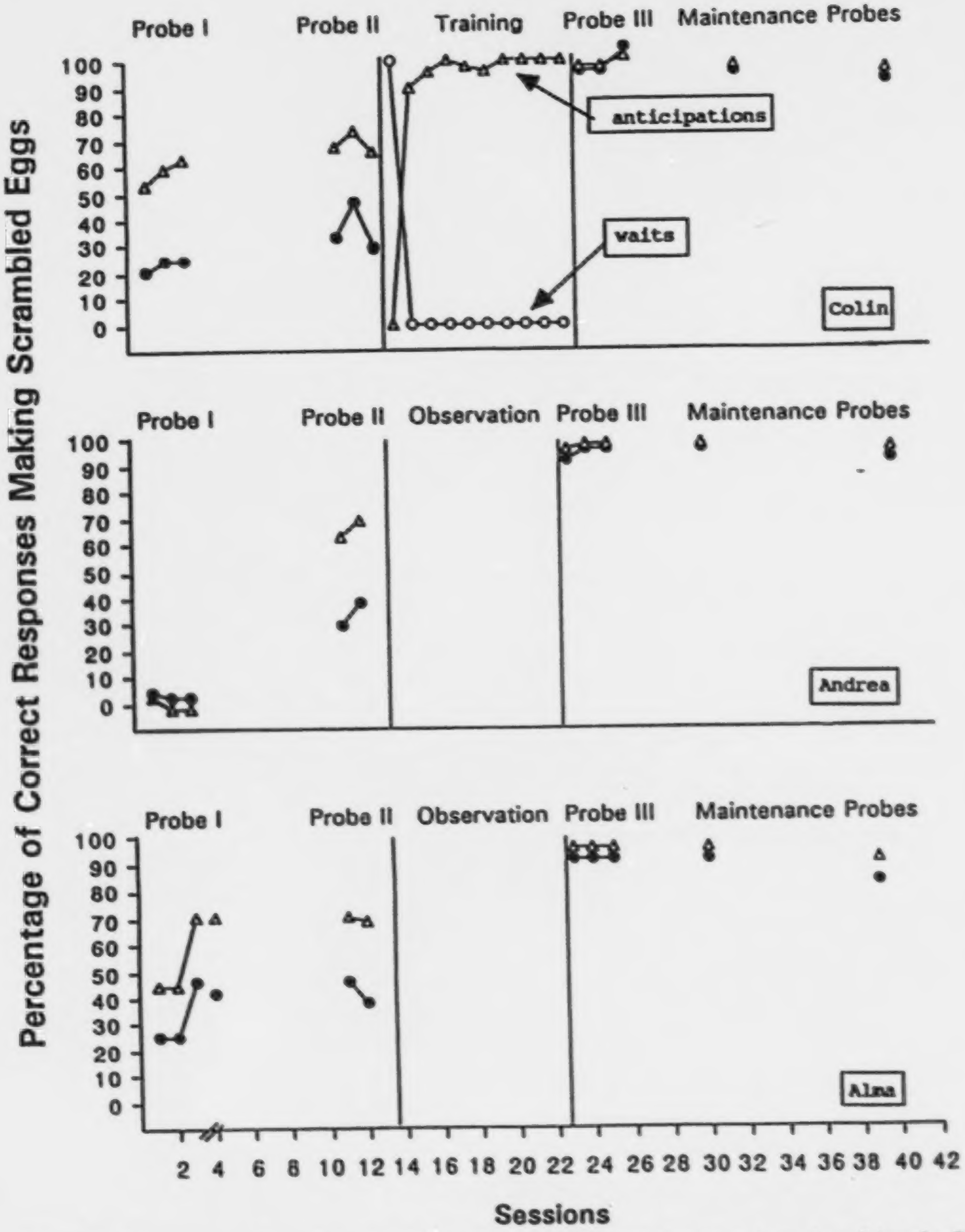

Figure 2. The percentage of correct responses for making scrambled eggs across experimental conditions for Colin (instructed student) is shown in the top graph; performance for Andrea and Alma (observing students) is shown in the middle and lower graphs, respectively. Scale breaks on the abscissa indicate absences of 1 to 7 days. Open triangles represent correct anticipations on all steps of the task analysis, closed circles represent correct anticipations on all steps excluding the page-turning steps, and open circles represent correct wait responses during training.

Figure 3. The percentage of correct responses for making pudding across experimental conditions for Andrea (instructed student) is shown in the top graph; performance for Alma and Colin (observing students) is shown in the middle and lower

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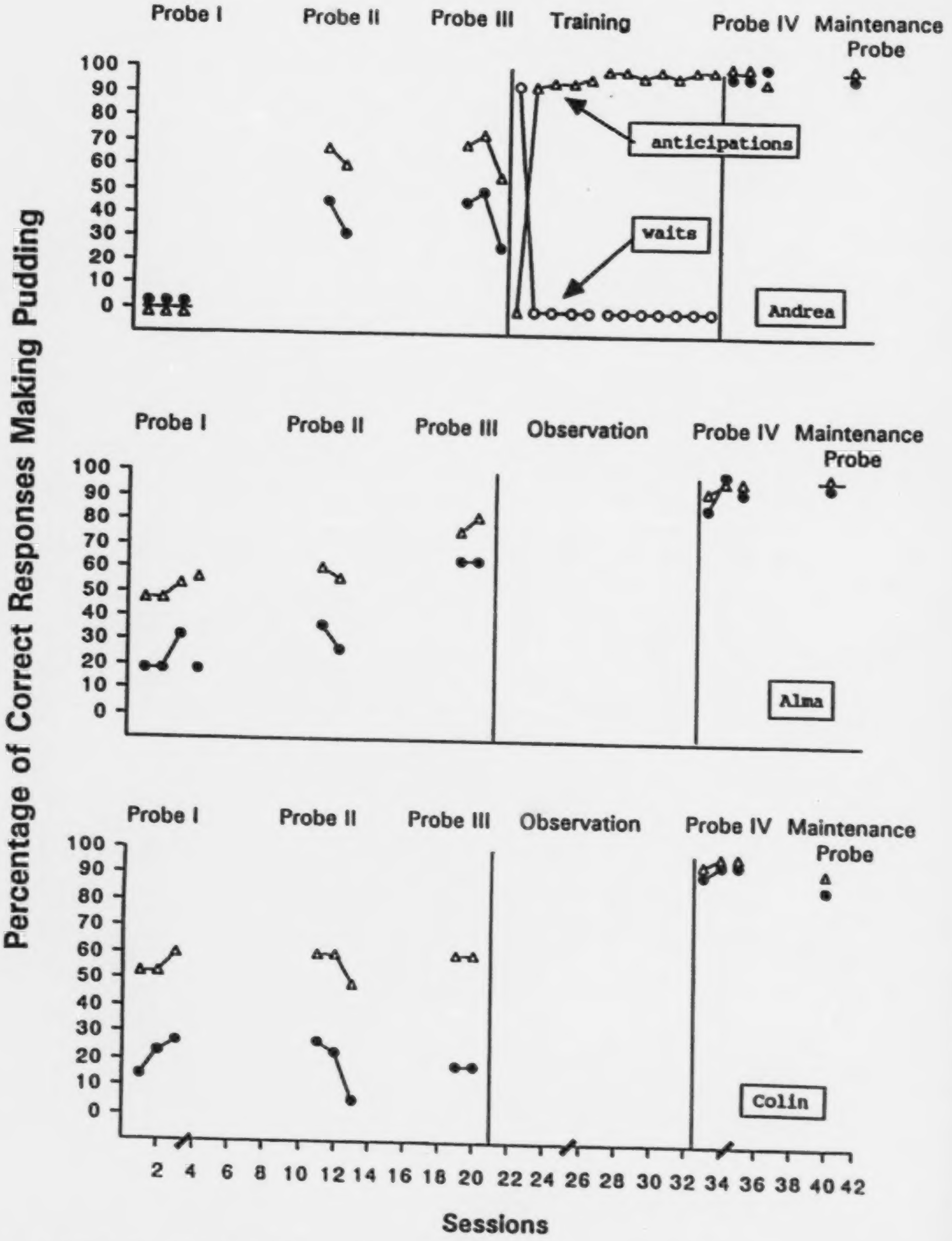

graphs, respectively. Scale breaks on the abscissa indicate absences of 1 to 7 days. Open triangles represent correct anticipations on all steps of the task analysis, closed circles represent correct anticipations on all steps excluding the page-turning steps, and open circles represent correct wait responses during training.

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Criterion level performance was maintained in Probe II (conducted immediately after training) and during maintenance probes (conducted 1, 3, and 5 weeks after Probe II). During training, Alma made 13 errors (2.2% of the trials); nine errors were topographical, three were duration, and one was a no-response error. All were nonwait errors.

Colin was directly taught to scramble eggs, and Andrea and Alma observed the instruction. Colin's performance during Probe I was stable between 21% and 25% correct (Figure 2). During Probe II, his performance ranged between 33% and 46% correct. Initiation of CTD training resulted in criterion level responding in 10 sessions. The mean session length was 17 min (range, 11.50 to 25.59). Criterion level performance continued during Probe III and during maintenance probes 1 and 3 weeks after Probe III. During training, Colin made 12 errors (2.4% of the trials); nine errors were topographical, two were duration, and one was a sequence error. Ten of Colin's errors were nonwait errors and two were wait errors.

Andrea was directly taught to make pudding, and Alma and Colin observed the instruction. Andrea performed at 0% correct during Probe I and between 27% and 50% correct during Probes II and III (Figure 3). Initiation of CTD training resulted in criterion level responding in 12 sessions. The mean session length was 11 min (range, 8.11 to 20.50). Criterion level performance continued during Probe IV and in a maintenance probe 1 week later. During training, Andrea made 13 errors (2.5% of the trials); six errors were topographical, six were duration, and one was a sequence error. Ten of Andrea's errors were nonwait errors and three were wait errors.

Thus, the CTD procedure was effective in teaching each student a chained snack preparation skill. Error percentages were low (2.4%), with the majority being nonwait topographical errors. Further, each student maintained high percentages of correct responses in the probe condition immediately following training and in maintenance probes.

Observational Learning

The percentage of steps completed correctly (including and excluding the page-turning behavior) are also presented in Figures 1, 2, 3 for the tasks of milkshake, scrambled eggs, and pudding. Colin and Andrea served as observers while Alma was taught to make a milkshake. During Probe I, Colin's correct responding ranged between 26% and 44%, and Andrea's correct responses were all 0%. After Alma displayed criterion level responding, Colin and Andrea's performance was again measured (Probe II). Both Colin and Andrea performed at 89% or higher on critical steps in all sessions; this level of performance was maintained in probes 1, 3, and 5 weeks after Probe II.

Andrea and Alma served as observers while Colin was taught to make scrambled eggs. During Probe I, Andrea's correct responding ranged between 0% and 4%, and during Probe II her correct responding was 29% and 38%. During Probes I and II, Alma's correct responding ranged between 25% and 46%. After Colin displayed criterion level responding, Andrea and Alma's performance was assessed during Probe III. Both Andrea and Alma performed at 92% or higher on critical steps in all sessions. Andrea maintained this level of performance in probes 1 and 3 weeks after Probe III. Alma maintained this level at the 1-week probe and dropped to 83% at the 3-week probe.

Alma and Colin served as observers while Andrea was taught to make pudding. During Probes I and II, Alma's correct responding ranged between 18% and 36%, and during Probe III her correct responding was 64% in both sessions. During Probes I, II, and III, Colin's correct responding ranged between 5% and 27%. After Andrea displayed criterion level responding, Alma and Colin's performance was assessed in Probe IV. Alma performed above 86% correct on critical steps in all sessions and was at 100% correct 1 week later. Colin performed above 91% correct during Probe IV and dropped to 86% 1 week later.

DISCUSSION

One purpose of this study was to assess the effectiveness of constant time delay in teaching chained responses to a triad of students with moderate mental retardation. The students did not perform at criterion levels on any task until training

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was implemented. Each student was directly taught and learned one skill with constant time delay. This finding extends previous research (Schoen & Sivil, 1989; Wolery et al., 1991) that demonstrated that constant time delay was effective with chained tasks in dyads. Whether this finding would occur if group size were increased awaits empirical demonstration. It should be noted that the data in some baseline sessions were ascending. For example, correct performance on critical steps was ascending for Alma (Figure 1), Colin and Andrea (Figure 2), and Andrea and Alma (Figure 3). Three factors separately or in combination may have contributed to this pattern. First, some of the steps (other than the page-turning steps) of the task analyses were redundant; thus, generalization across tasks may have occurred. Second, the pictorial recipe books were used during probes and may have acquired stimulus control of students' correct responding. Third, students were reinforced for correct responses during probe conditions. This reinforcement was included to ensure that learning of instructed tasks was a result of the instructional procedures rather than reinforcement or reinforcement plus the instructional procedures. Despite the ascending preinstruction performance, no student achieved criterion performance before being instructed or until observing a peer being taught. Abrupt changes in the percentage of correct anticipations occurred when instruction was initiated.

A second purpose was to determine whether the 2 observers would acquire the chained task taught to their peer in the triad. Each observer learned to perform the critical steps above 85% correct without direct instruction and displayed high levels of correct performance in maintenance probes. This finding is consistent with previous research with dyads and extends it to triads. This level of observational learning means that students can be taught chained tasks in small groups (of at least 3 students) in which one instructional trial per session is presented to only 1 student. At least three advantages of such instruction exist. First, teaching in triads is a more efficient use of teacher time than teaching one-to-one or in dyads. Second, with skills that use consumable materials (such as cooking tasks), the expense of instruction can be minimized. As reported by Schuster et al. (1988), cooking instruction can be expensive because the materials are not reusable. (In the current investigation, the cost of foods was $63.86.) Third, teaching in triads allows teachers to provide instruction to several students on routines that occur naturally at low frequencies. For example, if the task is cleaning a sink, then it would naturally be dirty only once or twice per day. By teaching in a triad, the teacher does not have to make the sink dirty for each student needing instruction.

In this study, a number of variables were manipulated to facilitate observational learning: (a) The teacher prompted the instructed student at the beginning of a trial to direct the observers to watch him or her perform the task, (b) the teacher directed the instructed student to prompt the observers to turn the page of the pictorial recipe book, (c) the teacher praised the observers for watching the instruction and turning the pages of the pictorial recipe book, (d) the teacher prompted 1 observer to praise the instructed student at the completion of the chain and prompted the other observer to deliver a token to the instructed student, and (e) all students received tokens and were allowed to exchange those tokens for back-up reinforcers. It is not possible from the data collected in this study to assess the separate effects, if any, of these manipulations. Such effects should be the focus of subsequent research. In many instances, the students performed these skills without teacher direction. Subsequent research should evaluate whether students perform these interactive components without prompts in other chained instructional tasks.

Students' abilities and instructional histories may have influenced their performance in this study. All subjects were imitative and identified reinforcers were used with each. Clearly, observational learning would not be expected for subjects who were not imitative, and it is unlikely that the delay procedure would be effective without use of reinforcers. Further, the subjects in this study had experience learning discrete behaviors in small groups, experience learning chained tasks in one-to-one instructional arrangements, and experience with constant time delay; 2 subjects (Colin and Alma) had experience with learning chained tasks in dyads. The contri-

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bution of these experiences to the outcome of this study cannot be assessed. However, one would expect the results to be most generalizable to students with this type of learning history and with the prerequisite skills displayed by these subjects.

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Appendix E

Effects of Independent and Interdependent Group Contingencies On Acquisition, Incidental Learning, and Observational Learning

Effects of Independent and Interdependent Group Contingencies on Acquisition, Incidental Learning, and Observational Learning

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Abstract

The purpose of this study was to evaluate the effects of two contingencies (independent and interdependent) on the learning of students with learning and behavioral disabilities when conducted in small groups with constant time delay. Eight students participated in the study; seven were taught four sets of behaviors and one was taught two sets. Measures were collected on the rapidity with which children learned under the two contingencies, the amount of observational learning that occurred, and the extent to which students acquired additional information that was included in the feedback for correct responses (i.e., incidental learning). A single subject design (adapted alternating treatments design) was used to evaluate the effects of the two contingencies. The results indicate that (a) both instructional arrangements were effective with all students and all behaviors; (b) the independent contingency condition resulted in more rapid learning than the interdependent contingency; (c) students acquired nearly all of the behaviors taught to their group members (observational learning), but it was not differentially affected by the two contingencies; and (d) students acquired some of the additional information presented in feedback events (incidental learning), but it also was not differentially affected by the two contingencies.

Effects of Independent and Interdependent Group Contingencies on Acquisition, Incidental Learning, and Observational Learning

Providing effective and efficient instruction to students with learning disabilities and mild mental retardation is a challenging task. Although numerous instructional strategies exist for teaching these populations (Mercer & Mercer, 1989), some strategies that were developed for students with severe disabilities are being evaluated with students who have milder disabilities. An example of such a strategy is the constant time delay procedure.

The constant time delay procedure involves the presentation of two types of instructional trials, 0-second trials and delay trials. In the 0-second trials, students are presented with a stimulus and task direction (e.g., "What's this?") and are immediately told the correct answer (i.e., teacher model). Students are reinforced for imitating the teacher's model. After one or two sessions conducted in this manner, delay trials are used. The students are presented with the stimulus and task direction and are given a fixed number of seconds to respond. If the student responds correctly, reinforcement is provided; if they do not respond, the teacher models the correct answer at the end of the delay interval, allows the student to imitate, and provides reinforcement. Constant time delay was effective in teaching multiplication facts (Cybriwsky & Schuster, 1988), sight words (Wolery, Ault, Gast, Doyle, & Mills, 1990), and spelling (Stevens, Blackhurst, & Slaton, 1991) to students with learning disabilities.

Recent research has begun to evaluate the relative efficiency of various strategies. Frequently, efficiency has been measured in terms of the rapidity with which learning occurs; specifically, the number of trials and minutes of instruction to criterion. If two strategies produce equal amounts of learning, the strategy that requires fewer instructional trials or minutes of instruction is considered more efficient. An alternative means of increasing the efficiency of instruction is to promote opportunities for observational and incidental learning. For example, if two strategies produce equally rapid acquisition of the behaviors taught to students, but one strategy also allows students to learn skills taught to his/her peers (observational learning) and/or to learn additional information that is not taught directly (incidental learning), then that strategy would be considered more efficient.

To promote observational learning, investigators have employed small group instructional arrangements in which each student is taught similar but different behaviors (Collins, Gast, Ault, & Wolery, 1991; Shelton, Gast, Wolery, & Winterling, 1991). To promote incidental learning (i.e., acquisition of stimuli not directly taught), investigators have used instructive feedback that involves presentation of additional stimuli during consequent events for correct responses (Gast, Doyle, Wolery, Ault, & Baklarz, 1991). Several studies have show that when such stimuli are added, students frequently acquire them, or some proportion of them, without direct instruction (Doyle, Gast, Wolery, Ault, & Farmer, 1990; Gast, Wolery, Morris, Doyle, & Meyer, 1990; Shelton et al., 1991; Stinson, Gast, Wolery, & Collins, 1991; Wolery, Alig-Cybriwsky, Gast, & Boyle-Gast, 1991).

In most direct instructional programs, systematic attention is given to the contingencies in effect. Two commonly used contingencies are independent and interdependent group contingencies (Litrow & Pumroy, 1975; McLaughlin, 1974). With independent contingencies, the reinforcer is provided to each student based on their own performance. With the interdependent contingencies, reinforcement is provided to all members of the group based on the group's performance regardless of each individual's contribution to the group outcome. Although considerable information exists on the effects of group contingencies on social and academic behaviors, no research to our knowledge addresses the effects of group contingencies on observational learning in small group arrangements or on incidental learning as described above. The purpose of this study was to compare the effects of independent and interdependent group contingencies when implemented in small group instructional arrangements with constant time delay on the performance of children with learning disabilities. Of interest was whether either contingency would differentially affect (a) the rapidity with which students acquired the instructed behaviors, (b) the amount of observational learning of other group members' instructed behaviors, and (c) the amount of incidental learning of extra information included in the feedback for correct responses.

Methods

Participants and Setting

Two groups of four children (ages 6-9 years) with learning disabilities participated in the study. All children in Group I (3 males and 1 female) were enrolled in a self-contained classroom for children with severe learning disabilities. Two children in Group II (1 male and 1 female) were enrolled in the same self-contained classroom as Group I children, and two children (2 males) were enrolled in a special education resource room for children with learning and behavioral disorders. Demographic information and target behaviors for students are presented in Table 1. In addition to normal visual and auditory functioning with corrective appliances as needed, students met the following criteria: (a) followed simple verbal directions, (b) waited for assistance from the teacher for at least 3 seconds on unknown tasks, (c) remained on task for at least 10 minutes in small group instruction, and (d) attended school regularly.

Insert Table 1 about here

Experimental sessions occurred in a small group arrangement in the students' classroom (5.4 m X 9.1 m) in a public elementary school. It contained one semi-circular table, a large teacher's desk, and eight small desks and chairs placed throughout the room. The instructional sessions were conducted daily by the classroom teacher at the semi-circular table. Students not receiving instruction were provided with other activities in the room away from the experimental setting.

Materials

For Group I, the target instructional stimuli were photographs of objects and places from the Photo Cue Cards kit (Kerr, 1985). No visual stimuli were used for Group II. Incidental information for both groups included words (of objects, places, and antonyms) printed in black on lower case letters on white cards (10cm X 15cm). For the instructional conditions (independent and interdependent group contingencies), a chart was used which contained squares for the number of correct responses required to access reinforcers at the end of the session. For the independent contingency, each student's photograph was displayed above the number of squares needed to access the reinforcer. For the interdependent contingency, a group photograph was displayed above the squares. A check was placed in each square for each unprompted correct response.

General Procedures

The sequence and purpose of each experimental condition are shown in Table 2. Initially, four sets of instructional stimuli were identified for each student; each set contained two target stimuli per student. Group I was taught to name pictures of functional objects and local places. Group II was taught to state the antonym for language concepts presented verbally by the teacher (e.g., "What is the opposite of 'least'?"). The antonyms were selected from the Bracken Basic Concepts Scale (Bracken, 1984). Each student in both groups learned behaviors different from their group members. Sets I and II for each subject were analyzed to ensure that they were of equal difficulty and then were randomly assigned to one of the two contingency conditions. This also was repeated for stimulus Sets III and IV. Stimuli were equated on the following variables: (a) selection of items from the same class, (b) demonstration of equal baseline performance (i.e., 0% correct on all behaviors), (c) approximate word length, (d) number of syllables, and (e) referent knowledge.

Insert Table 2 about here

Target-stimuli probe conditions (baseline assessment) were implemented for a minimum of three sessions before instruction and after students met criterion on each set. In addition, during probe conditions, students were assessed on their group members' target stimuli (observational-learning probes) and on the additional stimuli presented as feedback for correct responding during instruction (incidental-learning probes). The two instructional conditions (independent contingency and interdependent group contingency) were then used with separate sets of stimuli in two daily sessions, which were counterbalanced for time of day. Sets I and II were instructed first followed by Sets III and IV. In all instructional sessions, a 3-second constant time delay procedure was used until criterion level performance was achieved (i.e., two consecutive sessions at 100% unprompted correct responses).

The constant time delay procedure involved two types of trials, 0-second trials and 3-second delay trials, and used a verbal model of the target behavior as a controlling prompt (i.e., a prompt that would ensure correct performance). The 0-second delay trials were implemented during the first instructional session of each instructional condition and used the following trial sequence: For Group I, the teacher held up the stimulus card and said, "(Student's name), look, what is this?"; for Group II, the teacher said the task direction, "(Student's name), look; what's the opposite of (word)?" Immediately after these statements, the teacher said a verbal model of the correct response, waited 3-seconds for a response, provided the correct consequences for the student's response, and provided a 3- to 5-second intertrial interval. For the 3-second delay trials, the trial sequence was identical with one exception; the teacher provided a 3-second response interval between the task question and the presentation of the model.

Five responses were possible: unprompted correct responses, defined as the student saying the correct word after the task question but before the delivery of the model; prompted correct responses, defined as the student saying the correct word within 3 seconds of the model; unprompted errors, defined as the student saying any word other than the correct word after the task question but before the model; prompted errors, defined as the student saying any word other than the correct word within 3 seconds of the model; and no response errors, defined as the student not saying anything after the model. Each instructional session for both groups contained 6 trials per student, 3 on each target stimuli. The order of trials were randomly determined for each session.

The consequences for correct responses (unprompted and prompted) were verbal praise plus presentation of additional stimuli for incidental learning. For Group I, the teacher said, "Good," showed a written word of the object/place depicted in the picture and said, "this says (word)." For Group II, the teacher said, "Good," presented the written word for the antonym and said, "This says (word)" and stated a short definition of the word that appeared on the card. Students were not expected to respond to these stimuli, and statements by students about them were ignored. For unprompted correct responses, the teacher placed a check in a square on the chart used to provide feedback to the students about the availability of reinforcement following the session. For unprompted error responses, the teacher said, "Wait if you don't know and I'll tell you." For prompted errors and no responses, the teacher said, "Wrong," followed by a repetition of the correct word.

Target-stimuli probe conditions. Probe conditions were conducted before and after each instructional condition to assess students' performance on target stimuli. Probe conditions included a minimum of three sessions and occurred in the small group arrangement conducted by the teacher. Each session contained 8 individual trials (one per stimulus) for each subject. The trial sequence was as follows: The teacher held up the picture (Group I only), said the student's name, presented an attentional cue (i.e., said "Look"), ensured that the student looked, delivered the task direction (for Group I, she said, "What's this?"; for Group II she said, "What's the opposite of ______?"), and provided a 3-second response interval. Three responses were scored by the teacher during the intertrial interval. These were: correct responses, defined as the student stating the correct word within 3 seconds of the task question; error responses, defined as the student stating anything other than the correct word within 3 seconds; and no responses, defined as the student not saying anything within 3 seconds of the task question. Correct responses were praised verbally, and error and no responses were ignored; a 3- to 5-second intertrial interval was used.

Observational-learning probe procedures. Observational learning (students' acquisition of behaviors taught to their peers) was assessed in a single session before and after each instructional condition by the investigator. These sessions were conducted individually for each student and included 24 trials, one for each stimulus taught to the other members of the group. The trial sequence and response definitions were identical to those used in the target-stimuli probe condition.

Incidental-learning probe procedures. Incidental learning (students' acquisition of stimuli included in the feedback for correct responding) was assessed before and after each instructional condition for 3 sessions by the investigator. These sessions were conducted individually for each student and included 32 trials, one trial for each of their own incidental behaviors and one for each of their group member's incidental behaviors. For Group I, the incidental stimuli were written words of the objects and places. For Group II, two incidental stimuli occurred for each instructional target - one was the written word of the antonym and the other was the definition of the antonym. For Group I and II, the written words were assessed using the following trial sequence: The investigator held up the stimulus card with the word and said, "(Student's name), look."; when the student looked at the card, the investigator said, "What word?" and provided a 3-second response interval. For Group II, the definition of the antonym trial sequence was as follows: The investigator said, "(Student's name), look" and waited for the student to look at her. When the student looked, the investigator said, "What does (word) mean?" A 3-second response interval was provided. Response definitions and consequences were identical to the target-stimuli probe conditions.

Independent variable: Independent and interdependent group contingency. Two contingencies were compared in this study. In one daily session with one set of instructional stimuli, an independent contingency was used. In this condition, each student could earn a reinforcer (small edible) for themselves at the end of the session by performing a specified number of correct unprompted responses. If a student did not have the needed number of correct unprompted responses at the end of the session, no reinforcer was delivered. Thus, in this condition, some students could receive a reinforcer at the end of the session when other students in the group did not. In the other daily session with the other set of instructional stimuli, an interdependent group contingency was used. In this condition, students worked together to earn a reinforcer (small edible) and receipt of the reinforcer was based on the average performance of the group. If the group as a whole performed the number of correct responses needed to earn the reinforcer, then they all received a reinforcer. If, as a group, they did not have a sufficient number of correct unprompted responses, then no student received the reinforcer.

In both conditions, the number of correct unprompted responses needed to access the reinforcer increased based on the performance of students. Three levels were used: (a) 33% of the trials, (b) 66% of the trials, and (c) 100% of the trials. After two days of meeting a criterion level, the next one was implemented. In the independent contingency condition, the criterion levels were based on each child's individual performance. In the interdependent group contingency condition, the criterion levels were based on the group's performance. Prior to each instructional session, the teacher stated the contingency that was in effect while displaying the chart with the students' photographs and the number of squares equalling the number of correct unprompted responses required to access reinforcers. In the independent contingency, the teacher told each student how many correct unprompted responses were required; for the interdependent contingency, the teacher told all the students as a group.

Review trial procedures. If students met criterion in one condition (i.e., independent or interdependent contingencies) before the other, review trials were provided. This involved one instructional trials on each student's target stimuli. The trial sequence was identical to that used during instruction.

Experimental Design

An adapted alternating treatments design replicated across 8 subjects and four sets of behaviors was used to evaluate the effects of the two contingencies (Sindelar, Rosenburg, & Wilson, 1985). This design is a single-subject design allowing comparison of two instructional conditions (in this case contingencies) on the acquisition of sets of independent but equally difficult behaviors. Probe conditions are implemented to assess students' performance on behaviors prior to instruction, and then the two instructional conditions are applied to independent sets of behaviors in alternating daily sessions. Performance in each instructional condition was compared to probe performance to assess their effectiveness. Performance in the two instructional conditions were compared to one another to assess the relative merits of the two procedures.

The sequence of conditions were (a) Probe I - assess students' performance on stimulus Sets I-IV; (b) Instructional Comparison I - teach Set I with the independent contingency and teach Set II with the interdependent contingency in daily alternating sessions; (c) Probe II - assess students' performance on stimulus Sets I-IV; (d) Instructional Comparison II - teach Set III with the independent contingency and teach Set IV with the interdependent contingency; and (e) Probe III - assess students' performance on stimulus Sets I-IV. Also, observational and incidental learning were assessed at each probe condition.

Reliability

Reliability data were collected on students' performance (Tawney & Gast, 1984) and on the fidelity with which the teacher implemented the experimental conditions (Billingsley, White & Munson, 1980). Interobserver agreement and procedural reliability data were collected in at least 33% of the sessions for each condition by the investigator. A point-by-point method of computing interobserver agreement percentages was used: the number of agreements were divided by the number of disagreement plus agreements and multiplied by 100. For procedural reliability, the following teacher behaviors were assessed: stating the contingency that was in effect, asking the group if they were ready, waiting for an affirmative response, presenting the target stimulus, asking the student to look, ensuring that the student looked, stating the task direction, using the correct delay interval (0 or 3 seconds) and providing the prompt (if needed), providing the correct consequent events, recording the trial, and waiting the intertrial interval. Procedural reliability estimates were calculated by dividing the number of observed behaviors in each of the above categories by the number of planned behaviors in each category and multiplying by 100 (Billingsley et al., 1980).

Results

Reliability

For Group I, interobserver agreement on students' responding and procedural reliability were assessed in 33% of the probe sessions, 46.6 % of the independent contingency instructional sessions, and 51.5% of the interdependent contingency instructional sessions. For Group II, interobserver agreement on students' responding and procedural reliability were assessed in 45.4% of the probe sessions, 75% of the independent contingency instructional sessions, and 36.3% of the interdependent contingency instructional sessions.

Interobserver agreement. For Group I, the interobserver agreement scores during probe conditions were 100% for all subjects. For the independent contingency condition, it was 100% for Michael, Natalie, and Lane, and 98.8% (range of 83.3-100) for Ronald. For the interdependent contingency condition, the scores were 100% for Michael, Natalie, and Lane; and 97.8% (range 66.7-100) for Ronald. All scores were 100% for Group II.

Procedural reliability estimates. For Group I, probe conditions were implemented correctly at 100% except for providing the correct consequent event (mean of 99.2, range 96.9-100). In the independent contingency condition, correct implementation was 100% for all behaviors except presenting the stimulus (mean of 99.7, range of 95.8-100), providing the correct consequent events (mean of 99.7, range of 95.8-100), and waiting the correct response interval (mean of 99.7, range of 95.8-100). In the interdependent contingency condition, correct implementation was 100% for all behaviors except providing the correct consequent events (mean of 99.7, range of 95.8-100) and waiting the correct response interval (mean of 99.3, range of 95.8-100).

For Group II, the percent of correct implementation during probe conditions was 100 for all behaviors except the teacher securing an attending response (mean of 98.3, range 91.7-100). In the independent contingency condition, the percent of correct implementation was 100 for all behaviors except delivering the task direction (mean of 99.7, range of 95.8-100) and waiting the correct response interval (mean of 99.3, range of 95.8-100). In the interdependent contingency condition, the percent of correct implementation was 100 for all behaviors except presenting the correct consequent events (mean of 98.2, range 91.7-100) and waiting the correct intertrial interval (mean of 98.7, range of 88.9-100).

Effectiveness of the Two Contingencies

Group I. The two contingencies and constant time delay were effective in teaching all instructed behaviors to all students. These data are presented in Figures 1-4. For stimulus Sets I and II, no student had a correct response during Probe I. Upon introduction of instruction, all students met criterion. During Probe II, all students maintained criterion level performance on Sets I and II, and all students had 0% correct performance on Sets III and IV except for Michael who had some correct responses on Set IV. When instruction was implemented on Sets III and IV, all students met criterion. All students had at least two sessions of 100% correct performance during Probe III on all sets.

Insert Figures 1, 2, 3, and 4 about here

Group II. The two contingencies and constant time delay were effective in teaching all instructed behaviors to all children. These data are presented in Figures 5-8. For stimulus Sets I and II, no student had a correct response during Probe I. After introduction of instruction, all students met criterion. During Probe II, all students maintained criterion level performance on Sets I and II, and all students had 0% correct performance on Sets III and IV. When instruction was implemented on Sets III and IV, all students who were instructed met criterion. One student, Ford, was transferred to another school after Probe II, and did not participate in training on Sets III and IV. All students who participated in Probe III displayed higher performance than in Probes I and II.

Insert Figures 5, 6, 7, and 8 about here

Effects of the Two Contingencies on the Efficiency of Acquisition

The effects of the two contingencies were evaluated by comparing the number of trials, errors, and minutes of instruction to criterion and the percent of errors to criterion. These measures were calculated from the first instructional session until each student met criterion (i.e., two consecutive sessions at 100% correct unprompted responses). The data for both groups are presented in Table 3.

Insert Table 3 about here

For each measure (number of trials, errors, and minutes of instruction, and percent of errors), 15 opportunities existed to compare the effects of the two contingencies (4 comparisons for Group I on Sets I and II, 4 for Group I on Sets III and IV, 4 for Group II on Sets I and II, and 3 for Group II on Sets III and IV). In terms of trials to criterion, the independent contingency required fewer trials than the interdependent contingency on 10 of the 15 comparisons, was equal on three, and required more trials on two. Across all sets and subjects, the independent contingency required 76.4% of the trials required by the interdependent contingency. In terms of minutes of instructional time, the independent contingency required fewer minutes on all 15 comparisons than the interdependent contingency. Across all sets and subjects, the independent contingency required 73.4 percent of the minutes of instructional time required by the interdependent group contingency. In terms of the number and percent of errors to criterion, the independent contingency produced fewer errors and lower error percentages on 12 of the 15 comparisons, was equal in one case, and produced more errors in two cases. Across all sets and subjects, the independent contingency produced 41.2% of the errors produced in the interdependent contingency. Based on these data, it appears that the independent contingency resulted in more efficient acquisition (i.e., more rapid learning) than the interdependent contingency.

Effects of the Two Contingencies on Observational Learning

Observational learning (students' acquisition of stimuli taught to group members) for both groups are presented in Table 4. In most cases, students did not respond correctly to their peers' stimuli prior to instruction; after instruction, the percent of correct responses were 100% during 24 of the 30 assessments. These data appear to indicate that the students' observational learning was not differentially affected by the two contingencies.

Insert Table 4 about here

Effects of the Two Contingencies on Incidental Learning

Incidental learning (students' acquisition of stimuli presented during feedback for correct responses) also was evaluated. For Group I, the incidental learning involved reading the word that represented the object or place depicted in the picture (target stimuli). For Group II, the incidental learning involved reading the word of the antonym and stating a definition of the antonym. Data are presented in Table 5 on each student's acquisition of the incidental information for their target stimuli and on each student's acquisition of the incidental information for their group members' target stimuli. Based on the data in Table 5, all students learned some of the incidental information for their own target behaviors. Some children (e.g., Michael in Group I and Mark in Group II) learned all of the incidental information for their own target stimuli, but other students (e.g., Lane in Group I and Luke in Group II) learned relatively little of the incidental information for their target behaviors. For Group II who had two types of incidental information (reading the word and stating a definition of it), the subjects tended to have higher percentages of correct responses on the word reading task. All students acquired some of the incidental information that was presented for their group members' target stimuli. The two contingency conditions did not appear to affect students' incidental learning differentially.

Insert Table 5 about here

Discussion

This study was conducted to evaluate the effects of two contingencies (independent contingencies and interdependent group contingencies) implemented in small group instructional sessions using constant time delay on the rapidity with which children acquired the targeted behaviors, other group members' targeted responses (observational learning), and additional information included in the feedback for correct responses (incidental learning). Six findings are evident from this study. First, the procedures were implemented as planned with a high degree of procedural fidelity. This finding is consistent with a large body of research indicating that teachers can be trained to implement constant time delay with a high degree of compliance with planned procedures (Wolery et al., in press).

Second, the two contingencies and constant time delay were effective in teaching all behaviors to all children. This finding replicates considerable earlier research documenting the effectiveness of constant time delay with students who have disabilities and independent contingencies (Wolery et al., in press). However, no previous study had documented that the procedure would be effective with interdependent group contingencies; thus, this study extends the existing research in this regard.

Third, in terms of the rapidity with which children acquired their target responses, the independent contingency produced more rapid learning than the interdependent group contingency. The differences in the number of trials and minutes of instruction to criterion, and the number and percent of errors to criterion were consistent across students and across the sets of stimuli and were of sufficient magnitude to be educationally relevant. For example, on the average, students learned the same number of behaviors in about one fourth fewer trials and one fourth fewer minutes of instructional time. Such a difference may represent a considerable saving of time over the course of a school year, meaning that this extra time could be devoted to other instructional tasks. In terms of errors, students made less than half as many errors in the independent condition as in the interdependent condition. An explanation for the superiority of the independent contingency may be related to the process of establishing stimulus control. As is well known, the use of continuous reinforcement results in more rapid establishment of stimulus control than intermittent reinforcement (Wolery, Ault, & Doyle, 1992). The independent contingency may have resulted in more consistent reinforcement for unprompted correct responses for each individual student than did the interdependent group contingency. An alternative but compatible explanation may be found in the cooperative teaching literature. Although group contingencies and other variables are related to higher levels of prosocial behavior than independent contingencies, learning appears to be facilitated by group goals and individual accountability (Slavin, 1989). The independent contingency may have communicated more individual accountability than the interdependent condition. The more rapid learning produced by the independent contingency in this study is at odds with two previous investigations comparing group and individual contingencies (McLaughlin, 1981, 1982). McLaughlin documented the superiority of interdependent contingencies over independent contingencies for students with learning disabilities on academic tasks (i.e., reading and spelling). However, three notable differences exist between this study and McLaughlin's. In McLaughlin's studies, the subjects were older than the students in this study. Also, in his studies, students earned points as part of the classroom token economy. In this study, the reinforcer was accessed (if earned) immediately after the session. Finally, in McLaughlin's studies the reinforcement for students in the individual contingency condition were yoked to the amount of reinforcement received by students in the group contingency condition. They were limited in the independent contingency condition by the amount of reinforcement available in the group contingency condition. In the current study, access to reinforcement was based solely on students' performance in relation to a preset and preannounced criterion. Clearly, these differences present opportunities for future research.

Fourth, in this study, students' observational learning was evaluated. Previous research (e.g., Shelton et al., 1991) indicates that when students are taught different skills in small group arrangements they are likely to acquire some of the skills taught to their group members. However, to our knowledge, no investigation has compared the effects of independent and interdependent group contingencies on observational learning. In this study, students acquired nearly all of the skills taught to their peers when both contingencies were used. This high level of learning may have masked any differences that existed between the two contingencies;

however, it is clear that considerable observational learning occurred.

Fifth, in this study, students' learning of extra stimuli included in the feedback for correct responses was evaluated. Previous research has documented that adding such information to the feedback will result in acquisition of that information (Stinson et al., 1991; Wolery, Alig-Cybriwsky, et al., 1991; Wolery, Doyle, et al., 1991). However, no study has evaluated the differential effects of independent and interdependent group contingencies as was done in this study. The results seem to indicate that all students acquired some of this extra information, some students acquired nearly all of the extra information, other students acquired much smaller amounts, and the two contingencies probably were not related to the amount of learning. Also, of interest, these students acquired some of the extra information that was presented to their peers; again, however, this learning was not differentially affected by the two contingencies.

Finally, unlike other studies, students in Group II were presented with two additional stimuli: the written word and a statement of the word's definition. The word was presented in visual form (i.e. written on a card) with a verbal comment from the teacher (i.e., "This says [word]."). The definition was presented only verbally, the teacher said, "(Word) means __." Although some students learned both stimuli, more learning clearly occurred on the written word than on the definition of the word. Several explanations may exist for this difference: The written word (a) may be easier to learn, (b) was presented through two sensory modalities, (c) was presented first, and (d) was repeated in the definition. Future research should address procedures for presenting multiple extra stimuli during feedback.

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Table 1

Description of Participants

Group Student	Gender	Age	Diagnosis and Test Results Medications, and Related Services Received	Target Behaviors	
				Independent Contingency	Interdependent Contingency
Group I					
Michael	Male	9 yr. 9 mo.	Learning Disability, but formerly Educable Mentally Handicapped. WISC-R Verbal IQ: 73; K-ABC: MPC: 65, Sequential. Processing: 89, Simultaneous Processing: 54; Taking Ritalin; Speech/Language, Occupational, and Physical Therapy.	dictionary jacks car dealership cemetery	album crossword puzzle parking lot skyscraper
Ronald	Male	7 yr. 4 mo.	Learning Disability; intellectual capacities undetermined; Columbia Mental Maturity Scale estimate: 81; Cognitive level estimate: low average range; Taking Ritalin; controlled seizures; Speech/Language Therapy.	yarn crochet hooks flea market greenhouse	thermostat sewing machine music store bakery
Natalie	Female	6 yr. 8 mo.	Learning Disability; K-ABC MPC: 95; Sequential Processing: 83; Simultaneous Processing: 106; Test of Early Language Development (TOLD): Standard Score: 76; Described as "autistic like."	kitty litter patterns drive-in theater	binoculars cooler operating room airport
Lane	Male	6 yr. 8 mo.	Learning Disability; Stanford Binet Form IQ: 82; WPPSI incomplete (4 subtests within average limits); correct hearing loss; controlled seizures; Speech/Language Therapy.	hot water bottle globe parking garage trailer park	toothpicks pliers museum handicapped parking
Group II					
Mark	Male	6 yr. 1 mo.	Learning Disability; WPPSI Full Scale IQ: 93, Verbal IQ: 81, Performance IQ: 107 TOLD, Standard Score: 85.	separate heavy arriving sharp	loose both farthest multiply
Carla	Female	9 yr. 8 mo.	Learning Disability; WISC-R Full Scale IQ 63, Verbal IQ: 66; Performance IQ: 67; Speech/Language Therapy.	all rough ending curved	unequal same start empty
Luke	Male	9 yr. 10 mo.	Educable Mentally Handicapped; WISC-R Full Scale IQ: 59, Verbal IQ: 60; Performance IQ: 65; Speech/Language Therapy.	always forward dim with	minus before less few
Ford	Male	7 yr. 8 mo.	Learning Disability; WISC-R Full Scale IQ: 89, Verbal IQ: 82, Performance IQ: 100; IQ: 82, Performance IQ: 100; TOLD, Standard Score: 67.	narrow thick	most deep

Table 2

Sequence and Purpose of Each Experimental Conditions

Condition	Purpose
Target-Stimuli Probe I	Conducted to assess students' initial performance on behaviors targeted for instruction (i.e., Stimulus Sets I, II, III, and IV).
Observational-Learning Probe I	Conducted to assess students' initial performance on behaviors that were to be taught to group members (i.e., Stimulus Sets I, II, III, and IV).
Incidental-Learning Probe I	Conducted to assess students' initial performance on stimuli presented during feedback for correct responses; included stimuli for each student's target behaviors and stimuli for group members.
Instructional Condition I	Conducted to evaluate the effects of independent (Stimulus Set I) and interdependent (Stimulus Set II) contingencies on students' learning.
Target-Stimuli Probe II	Conducted to assess students' performance on instructed behaviors (Sets I and II) and on behaviors to be taught (Sets III and IV).
Observational-Learning Probe II	Conducted to assess students' observational learning of behaviors taught to their peers (Sets I and II) and to assess their performance on behaviors that would be taught to their group members.
Incidental-Learning Probe II	Conducted to assess students' incidental learning of stimuli presented during feedback events for Sets I and II and to assess their performance on behaviors that would be taught to their group members.
Instructional Condition II	Conducted to evaluate the effects of independent (Stimulus Set III) and interdependent (Stimulus Set IV) contingencies on students' learning.
Target-Stimuli Probe III	Conducted to assess students' performance on all instructed behaviors (Sets I, II, III, and IV).
Observational-Learning Probe III	Conducted to assess students' observational learning of all behaviors taught to their group members.
Incidental-Learning Probe II	Conducted to assess students' incidental learning of stimuli presented during feedback events for all behaviors (Sets I, II, III, and IV).

Table 3

Number of Trials, Errors, and Minutes of Instructional Time to Criterion and Percent of Errors to Criterion for Groups I and II

Group Stimulus Sets Subject	Efficiency Measure					
	Number of Trials to Criterion		Number of Minutes to Criterion		Number (Percent) of Errors to Criterion	
Condition:	Independ.	Interdepend.	Independ.	Interdepend.	Independ.	Interdepend.
Group I						
Sets I & II						
Michael	60	66	64:36	70:05	0 (0.0%)	1 (1.5%)
Ronald	54	84	59:26	84:09	7 (13.0%)	17 (20.2%)
Natalie	42	60	41:06	65:05	0 (0.0%)	1 (1.7%)
Lane	42	42	41:06	49:08	3 (7.1%)	4 (9.5%)
Sub-total	198	252	64:36	84:09	10 (5.1%)	23 (9.1%)
Sets III & IV						
Michael	36	48	30:57	43:31	1 (2.7%)	4 (8.3%)
Ronald	36	42	30:57	38:31	1 (2.7%)	6 (14.3%)
Natalie	36	36	32:26	33:49	0 (0.0%)	0 (0.0%)
Lane	60	84	52:37	73:09	9 (15.0%)	15 (17.9%)
Sub-total	168	210	52:37	73:09	11 (6.5%)	25 (11.9%)
Total Group I	366	462	117:13	157:18	21 (5.7%)	48 (10.4%)
Group II						
Sets I & II						
Mark	36	66	28:47	35:25	0 (0.0%)	1 (1.5%)
Carla	72	66	55:40	57:19	8 (11.0%)	9 (13.6%)
Luke	36	84	28:47	70:01	5 (13.9%)	33 (39.6%)
Ford	48	36	40:50	33:10	3 (6.3%)	2 (5.5%)
Sub-total	192	252	55:40	70:01	16 (8.3%)	45 (17.9%)
Sets III & IV						
Mark	36	36	19:25	19:58	4 (11.1%)	0 (0.0%)
Carla	36	60	19:25	33:06	1 (2.8%)	7 (11.7%)
Luke	48	78	25:27	42:59	7 (14.6%)	19 (24.4%)
Ford	--	--	--	--	--	--
Sub-total	120	174	25:27	42:59	12 (10.0%)	26 (14.9%)
Total Group II	312	426	81:07	113:00	28 (9.0%)	71 (16.7%)
TOTAL Groups I & II	678	888	198:20	270:18	49 (7.2%)	119 (13.4%)

Table 4

The Percent of Observational Learning by Group and Contingency

Group Subject	Instructional Stimulus Sets							
	Set I and II				Set III and IV			
Condition:	Independ.		Interdepend.		Independ.		Interdepend.	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Group I								
Michael	0	100	0	50	0	100	0	100
Ronald	0	100	0	100	0	100	0	100
Natalie	0	100	0	100	0	100	0	100
Lane	0	100	0	100	0	100	0	100
Subtotal	0	100	0	87.5	0	100	0	100
Group II								
Mark	33	100	0	100	25	100	50	100
Carla	0	33	0	67	0	75	0	0
Luke	0	100	17	100	0	100	0	100
Ford	0	100	17	83				
Subtotal	8.3	83.3	8.5	87.5	8.3	91.7	16.7	66.7
Total for Groups I & II	4.1	91.6	4.3	87.5	3.6	96.4	7.1	85.7

Table 5

Percent of Correct Responses on Incidental Learning Measures

Group Stimulus Sets Student Condition:	Incidental Stimuli For Student's Target Behaviors				Incidental Stimuli For Group Members' Target Behaviors			
	Independ.		Interdepend.		Independ.		Interdepend.	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Group I (Word Reading)								
Sets I & II								
Michael	0	100	0	100	0	100	0	100
Ronald	0	50	0	100	0	83	0	67
Natalie	0	50	0	0	0	17	0	17
Lane	0	100	0	0	0	17	0	0
Subtotal	0	75	0	50	0	54.3	0	46
Sets III & IV								
Michael	0	100	0	100	0	100	17	100
Ronald	0	100	0	0	0	0	0	83
Natalie	0	100	0	100	0	50	0	17
Lane	0	0	0	0	0	0	0	0
Subtotal	0	75	0	50	0	37.5	4.3	50
Total Group I	0	75	0	50	0	45.9	2.1	48
Group II (Word Reading)								
Sets I & II								
Mark	50	100	50	100	100	100	100	100
Carla	0	100	0	0	17	67	0	50
Luke	0	100	0	100	0	0	0	50
Ford	50	50	0	100	0	83	0	100
Subtotal	25	87.5	12.5	75	29.3	41.8	25	75
Sets III & IV								
Mark	0	100	0	100	75	100	100	100
Carla	0	100	0	100	25	50	25	50
Luke	0	50	0	50	0	0	0	0
Ford	--	--	--	--	--	--	--	--
Subtotal	0	83.3	0	83.3	33.3	50	41.7	50
Group II (Stating Word Definition)								
Sets I & II								
Mark	0	100	0	100	17	100	100	100
Carla	0	0	0	50	0	17	0	17
Luke	0	0	0	0	17	0	0	50
Ford	0	0	0	0	17	0	0	0
Subtotal	0	25	0	37.5	12.8	29.3	25	41.8
Sets III & IV								
Mark	0	100	0	100	0	75	0	75
Carla	0	0	50	0	0	0	0	0
Luke	0	50	0	0	0	75	0	25
Ford	--	--	--	--	--	--	--	--
Subtotal	0	50	16.7	33.3	0	50	0	33.3

Figure Captions

Figure 1. Percent of unprompted correct responses (triangles) and prompted correct responses (open circles) for Michael during probe and instructional conditions. Dashed horizontal lines indicate levels required to receive reinforcement in each instructional condition.

Figure 2. Percent of unprompted correct responses (triangles) and prompted correct responses (open circles) for Ronald during probe and instructional conditions. Dashed horizontal lines indicate levels required to receive reinforcement in each instructional condition.

Figure 3. Percent of unprompted correct responses (triangles) and prompted correct responses (open circles) for Natalie during probe and instructional conditions. Dashed horizontal lines indicate levels required to receive reinforcement in each instructional condition.

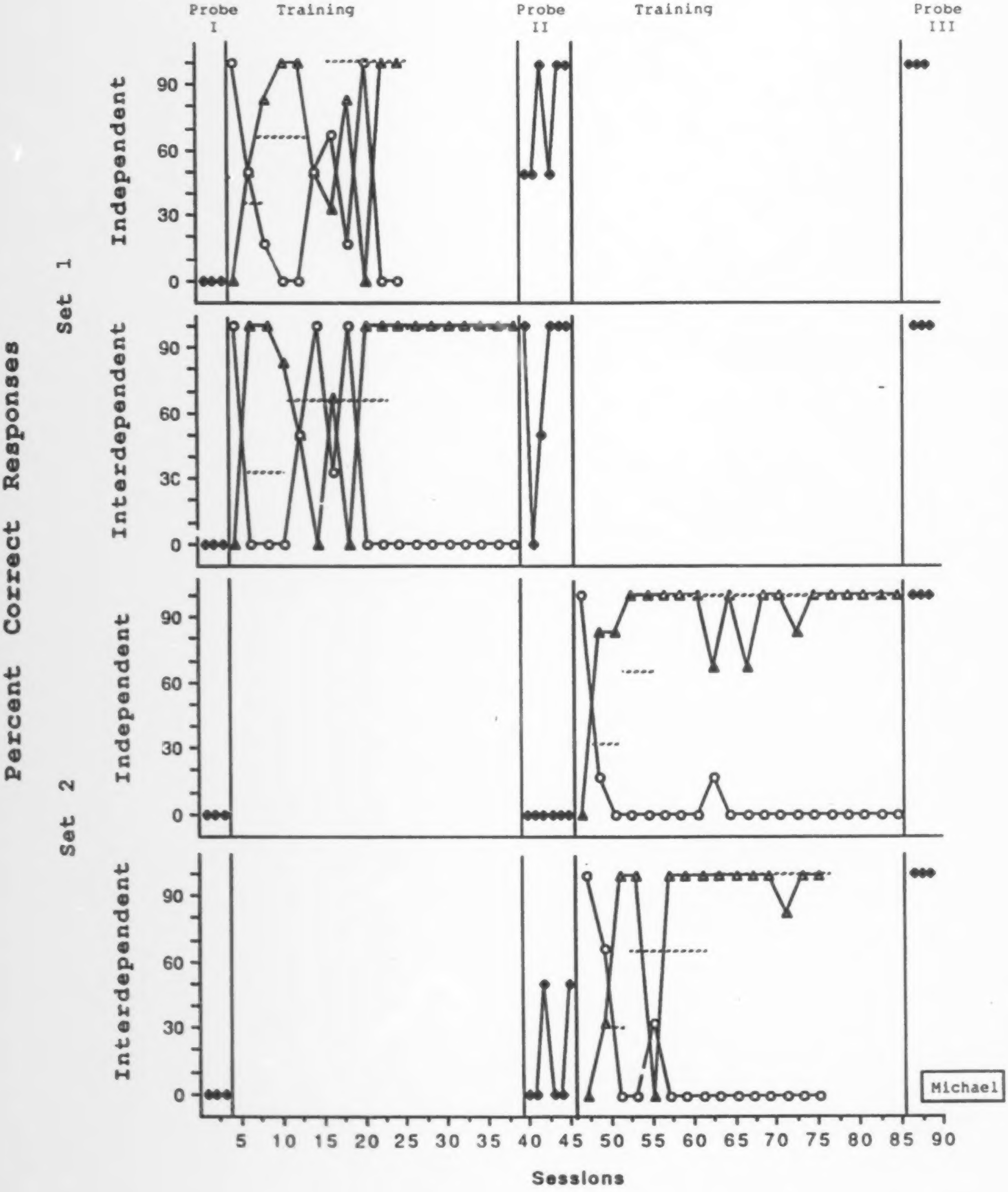
Figure 4. Percent of unprompted correct responses (triangles) and prompted correct responses (open circles) for Lane during probe and instructional conditions. Dashed horizontal lines indicate levels required to receive reinforcement in each instructional condition.

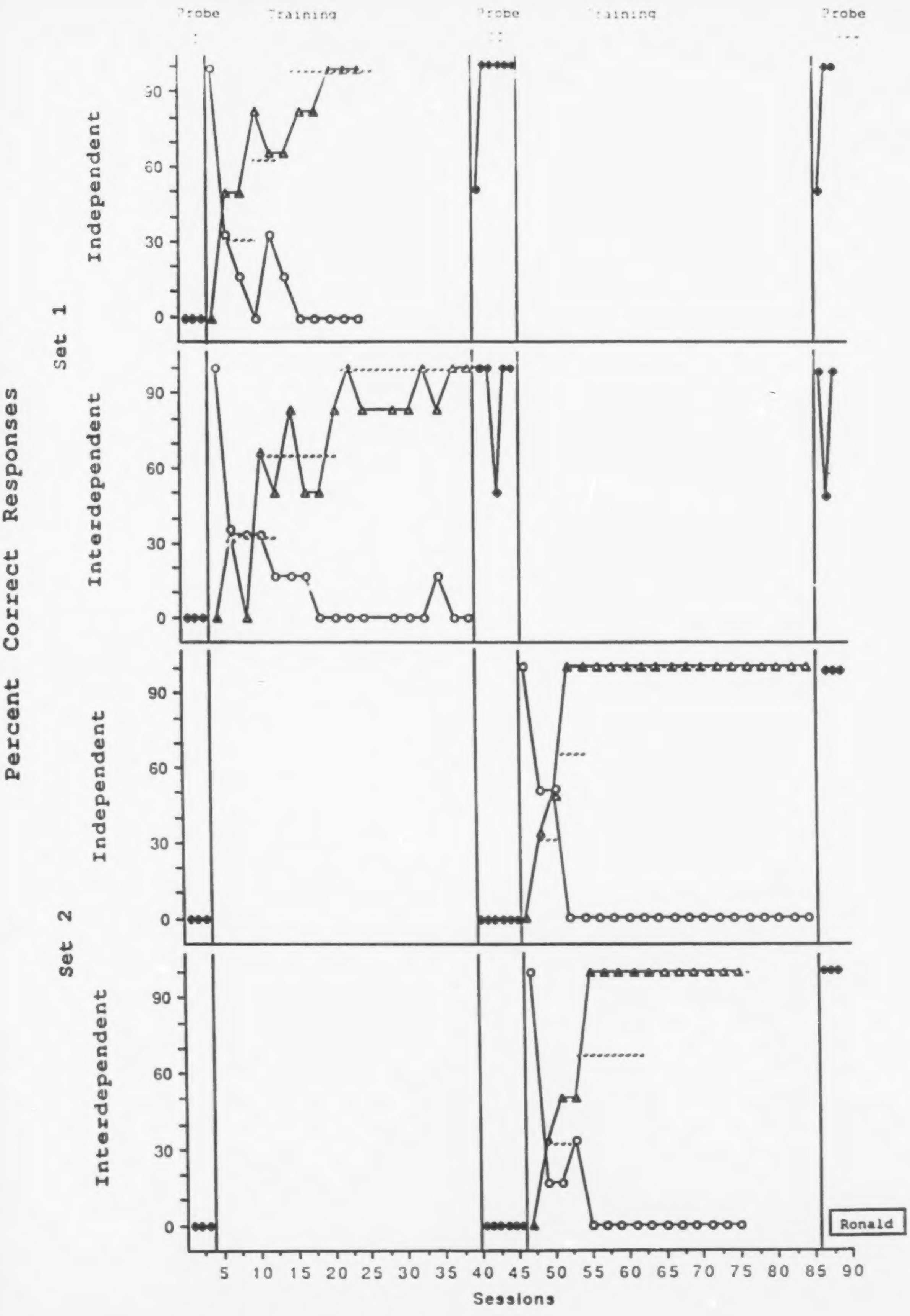
Figure 5. Percent of unprompted correct responses (triangles) and prompted correct responses (open circles) for Mark during probe and instructional conditions. Dashed horizontal lines indicate levels required to receive reinforcement in each instructional condition.

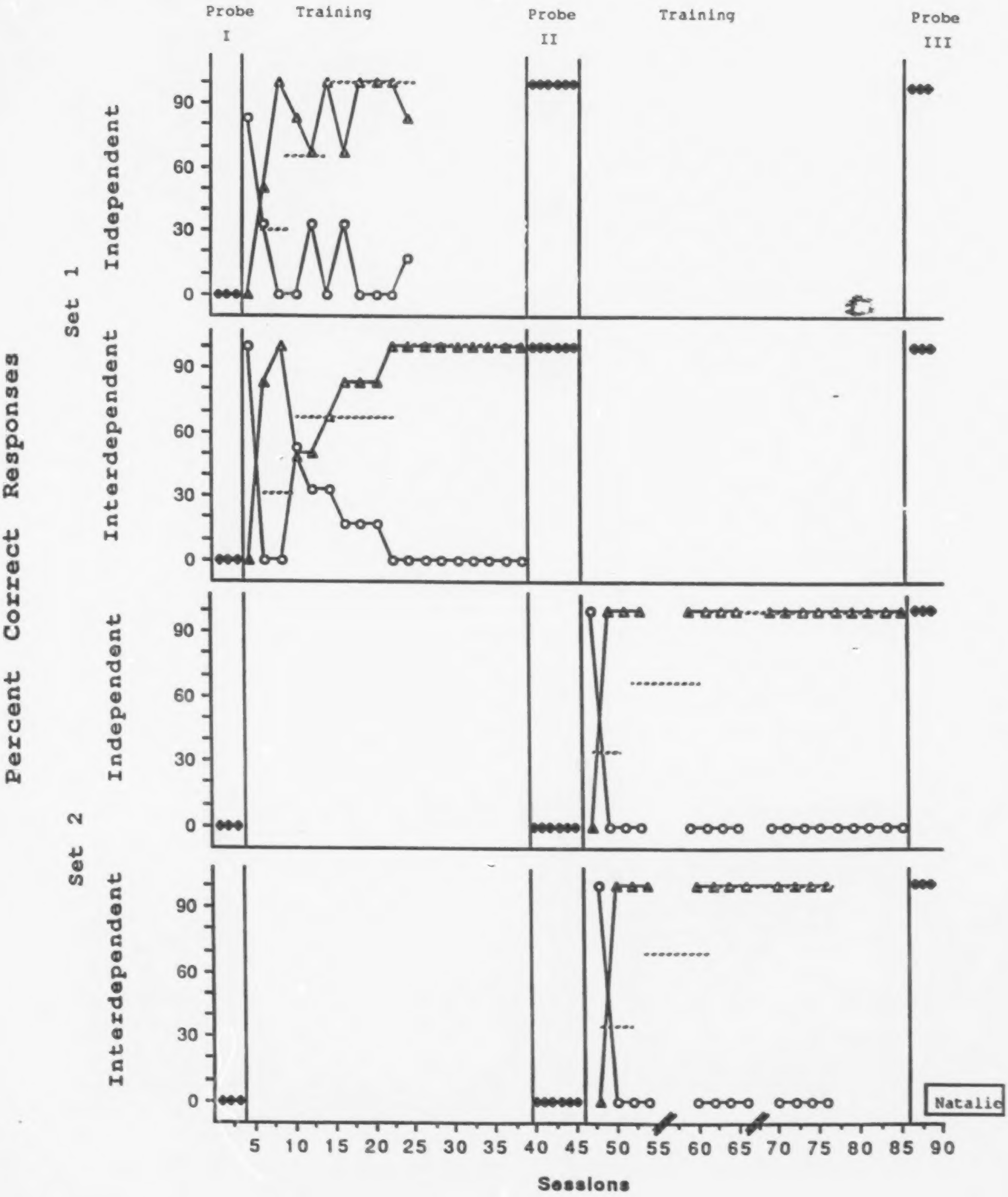
Figure 6. Percent of unprompted correct responses (triangles) and prompted correct responses (open circles) for Carla during probe and instructional conditions. Dashed horizontal lines indicate levels required to receive reinforcement in each instructional condition.

Figure 7. Percent of unprompted correct responses (triangles) and prompted correct responses (open circles) for Luke during probe and instructional conditions. Dashed horizontal lines indicate levels required to receive reinforcement in each instructional condition.

Figure 8. Percent of unprompted correct responses (triangles) and prompted correct responses (open circles) for Ford during probe and instructional conditions. Dashed horizontal lines indicate levels required to receive reinforcement in each instructional condition.


Probe I
Training
Probe II
Training
Probe III
Percent Correct Responses
Set 1
Set 2
Independent
Interdependent
Independent
Interdependent
0
30
60
90
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
Sessions
Michael


Probe I
Training
Probe II
Training
Probe III
Percent Correct Responses
Set 1
Set 2
Independent
Interdependent
Independent
Interdependent
0
30
60
90
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
Sessions
Ronald


Probe
I
Training
Probe
II
Training
Probe
III
Percent Correct Responses
Set 1
Set 2
Independent
Interdependent
Independent
Interdependent
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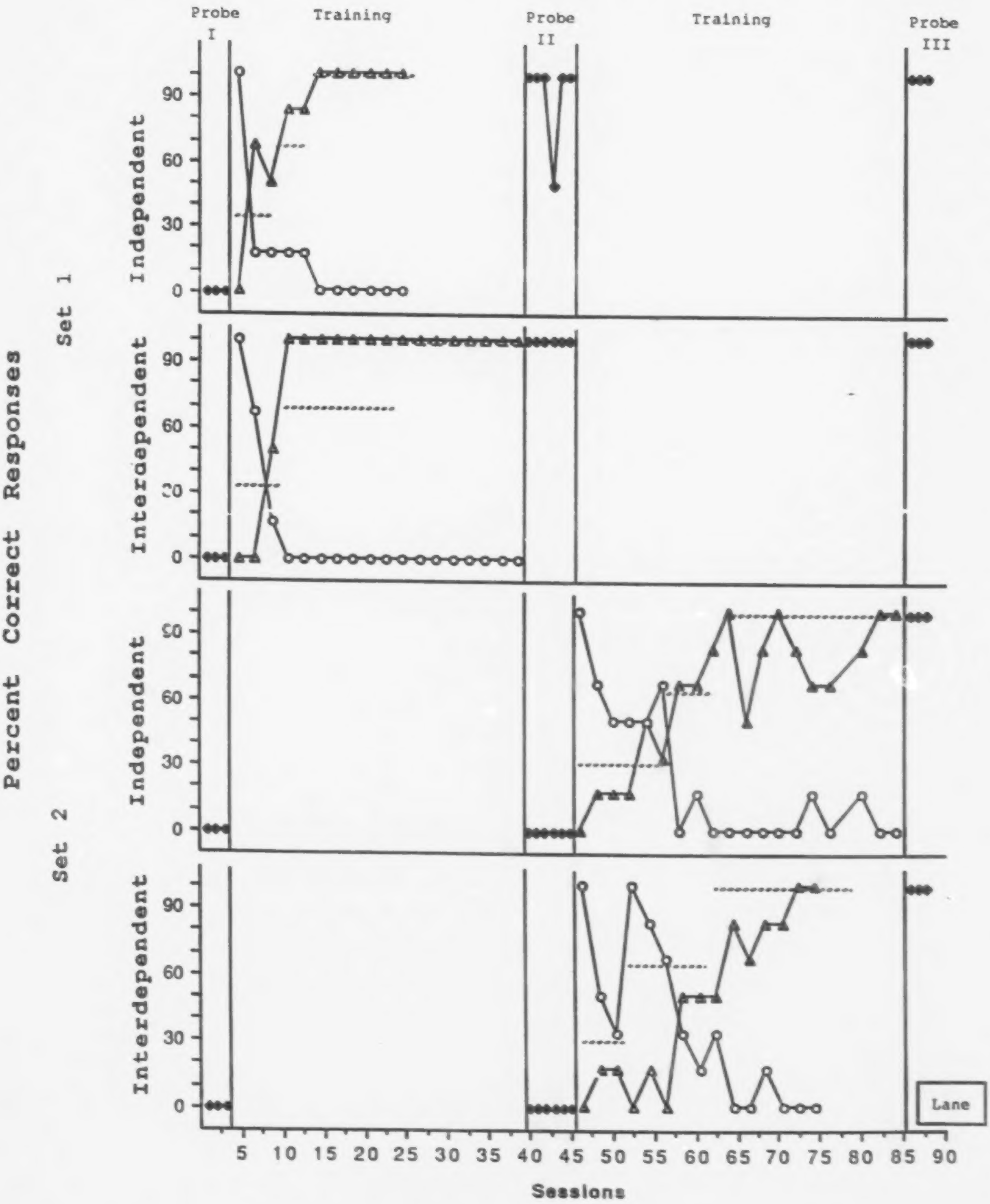
60
30
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
Sessions
Natalie


Probe I
Training
Probe II
Training
Probe III
Percent Correct Responses
Set 1
Set 2
Independent
Interdependent
Independent
Interdependent
0
30
60
90
5
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35
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55
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65
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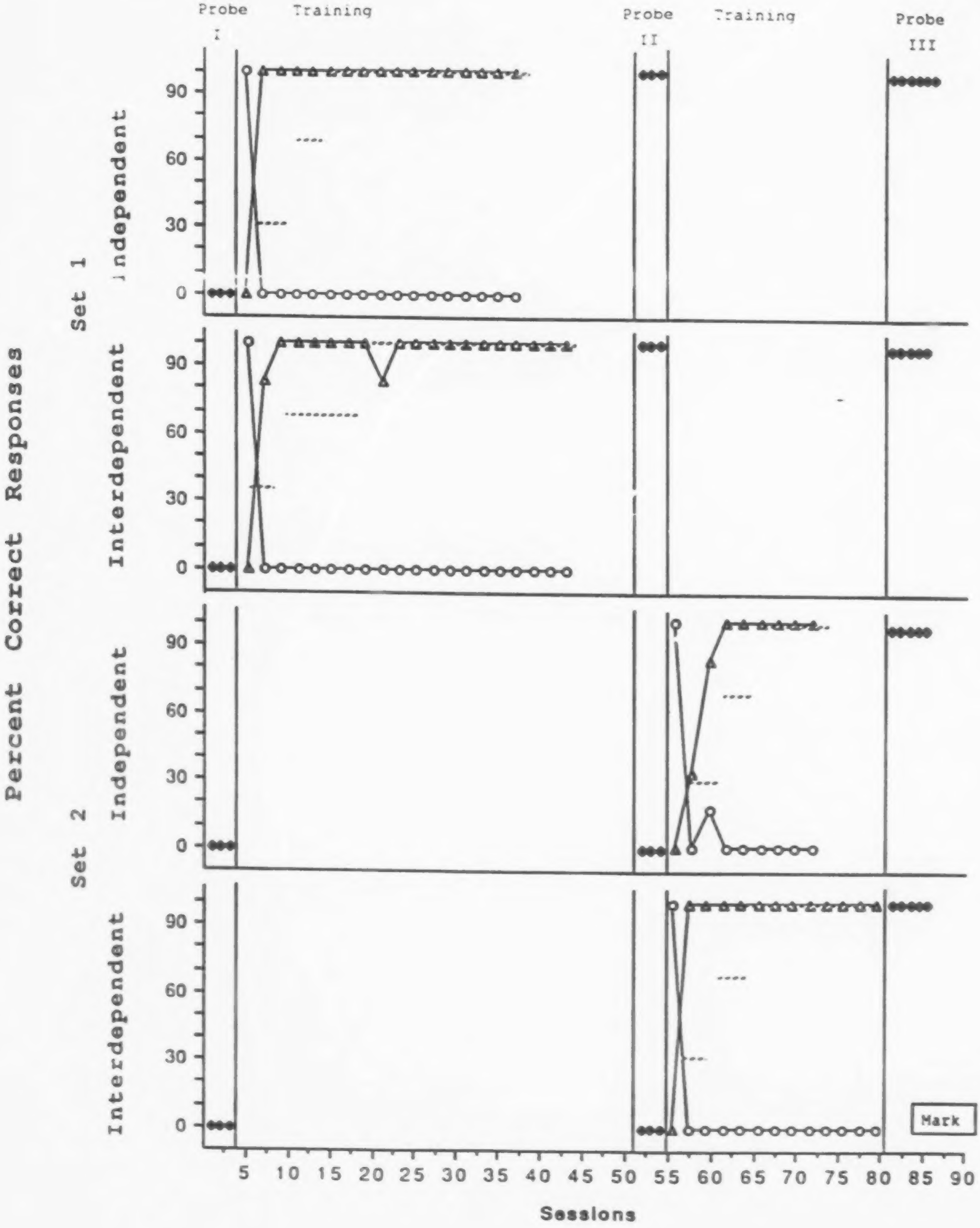
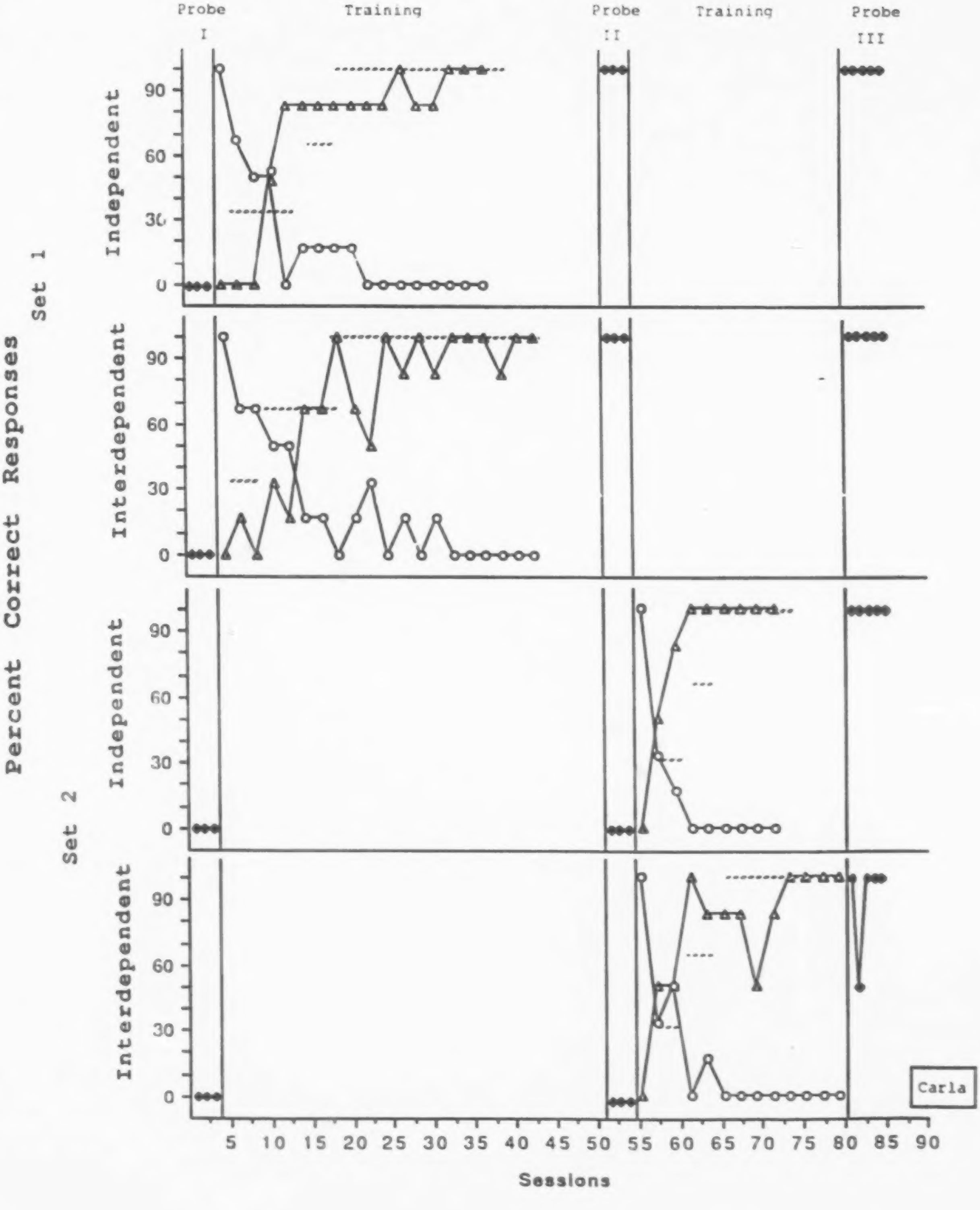
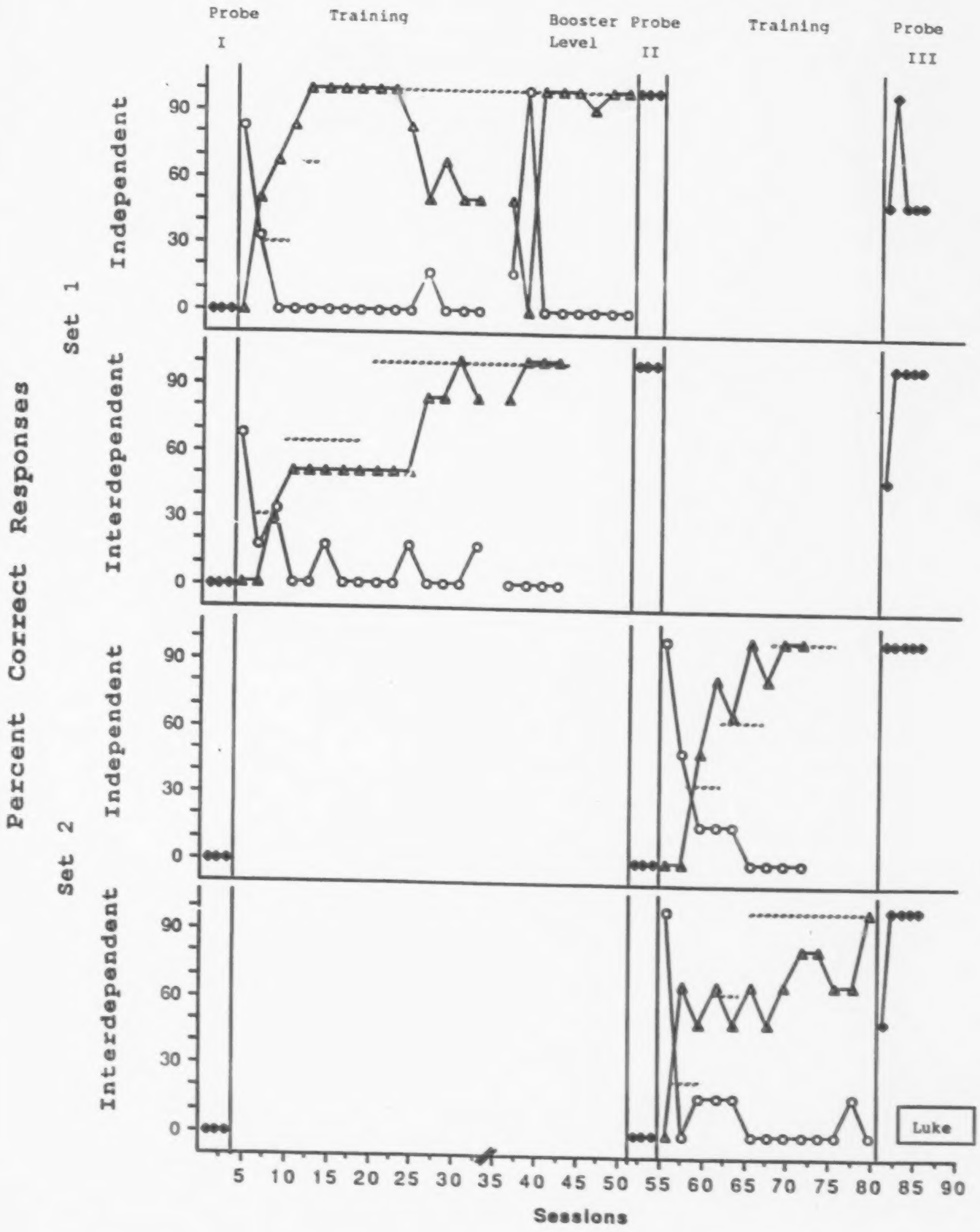
75
80
85
90
Sessions
Lane


Probe I
Training
Probe II
Training
Probe III
Percent Correct Responses
Set 1
Set 2
Independent
Interdependent
Independent
Interdependent
0
30
60
90
Mark
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
Sessions


Probe I
Training
Probe II
Training
Probe III
Percent Correct Responses
Set 1
Set 2
Independent
Interdependent
Independent
Interdependent
0
30
60
90
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
Sessions
Carla


Probe I
Training
Booster Level
Probe II
Training
Probe III
Percent Correct Responses
Set 1
Set 2
Independent
Interdependent
Independent
Interdependent
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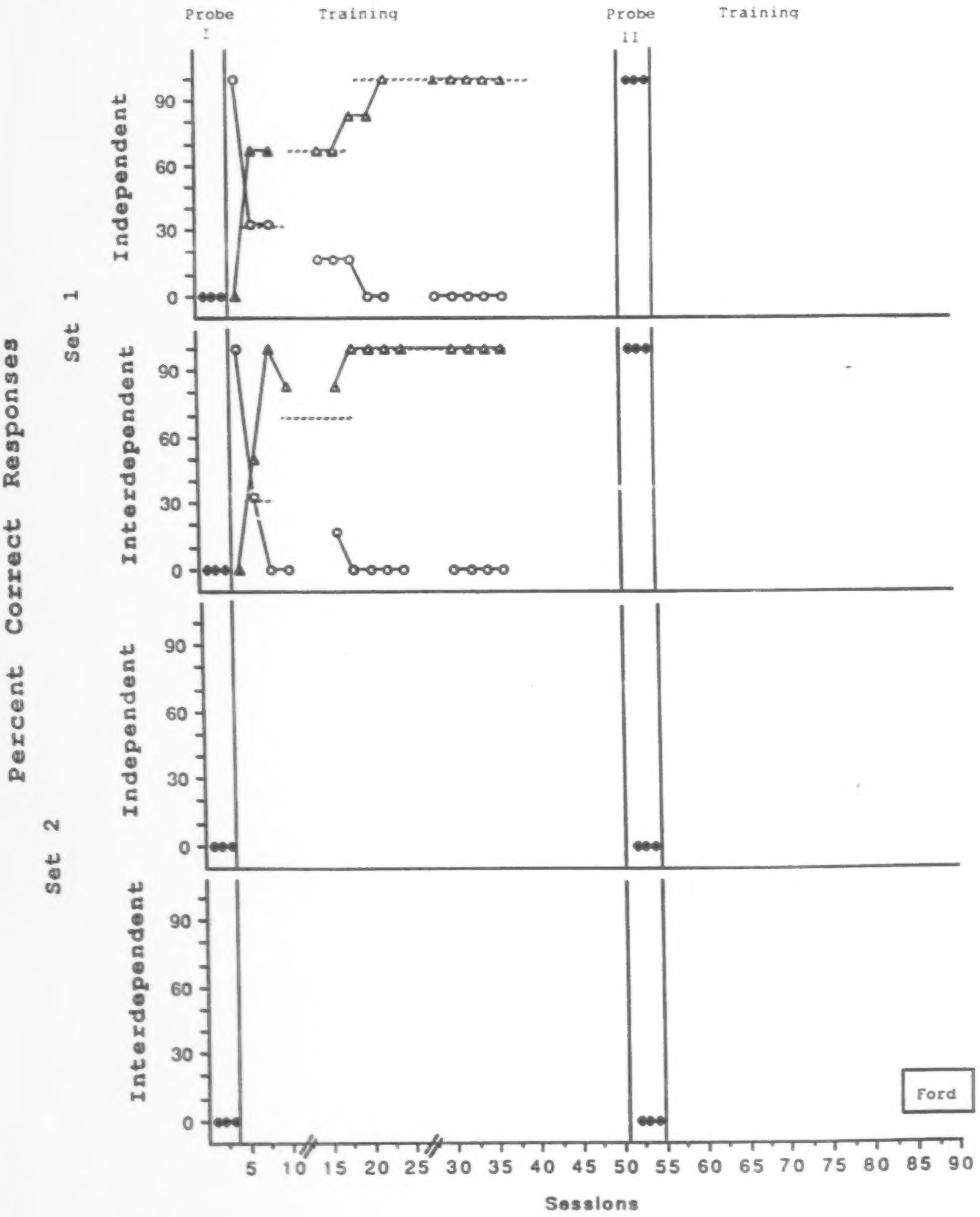
30
60
90
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
Sessions
Luke


Probe I
Training
Probe II
Training
Percent Correct Responses
Set 1
Set 2
Independent
Interdependent
Independent
Interdependent
0
30
60
90
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
Sessions
Ford

Appendix F

Efficacy of Transition-Based Teaching With Instructive Feedback

Efficacy of Transition-Based Teaching with Instructive Feedback[1]

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Abstract

The efficacy of implementing a small number of transition-based teaching trials with instructive feedback was investigated to determine whether preschool students with hearing impairments would acquire pre-academic skills. Trials to teach naming of shapes were dispersed throughout the day with one trial per child in a transition from one class activity to another. The teachers provided the instructive feedback (colors of the shapes) in praise statements following correct responses. Students were assessed to determine whether they could generalize these skills to other materials. The results indicate that the constant time delay procedure delivered during transition was effective in establishing acquisition of preacademic skills, and all students were able to generalize some shape names to materials other than the training stimuli. Additionally, all students generalized some of the color names although there was no direct instruction on these stimuli.

Efficacy of Transition-Based Teaching with Instructive Feedback

Devising instructional opportunities for preschoolers in center-based programs requires structuring the physical and social dimensions of the classroom, providing appropriate materials, scheduling activities, and selecting and using effective instructional practices to teach high-priority objectives to each child. High structure activities (e.g., circle-time, small group and individual instructional sessions) and low-structure activities (e.g., snack, free play, activity areas) are viable instructional contexts for young children (Bailey & Wolery, 1992). However, a significant amount of each day is consumed by non-instructional time such as transitions or moving from activity to another. Investigators have found that as much as 20% or more of preschool class time is spent in transitions from one activity to another (Sainato & Lyon, 1983: Conference presentation cited in Sainato, Strain, Lefebvre, & Rapp, 1987). Other research has attempted to decrease duration of transitions and to promote independence (Rosenkoetter & Fowler, 1986; Venn, Wolery, Morris, DeCesare, & Sigesmund, 1992) In general, transitions are viewed as necessary events (i.e., to allow movement from one instructional area to another), but as times when disruptive behavior is likely and instruction is minimal. Given that children transitioning with relative independence and that the duration of the classroom transitions is within reason, then, it seems desirable to plan some transitions to make them more productive without adding significantly to the time needed.

Transition-based teaching is a technique designed to use transitions as instructional opportunities thus reducing the amount of time during the school day that is spent in unplanned, non-productive activities. The technique involves delivering a brief trial during a transition. By dispersing a preplanned number of trials per day, the teacher can systematically deliver instruction during a time that ordinarily is non-productive. Wolery, Doyle, Gast, Ault, and Simpson (in press) compared transition-based teaching to an established, direct instructional procedure. Children were taught sight words, letter and numeral naming, and manual signs for photographs. One set of behaviors was taught in a massed trial, 1:1 instructional arrangement with progressive time delay. A second set of behaviors was taught during transitions between activities (transition-based teaching). In the transition-based teaching procedure, the teacher provided one brief instructional trial during most (10) transitions of the day. Both instructional procedures were equally effective, and minimal differences in their efficiency were noted. Thus, transition-based teaching may be a viable means of rapidly teaching preacademic content. One difficulty in implementation was the number of trials that were attempted during the half-day program.

Another procedure that has been used to increase the efficiency of instruction is instructive feedback. Instructive feedback is the addition of related, non-target information to the consequent events of instructional trials (Werts, Wolery & Holcombe, 1991). Several studies have documented that when such information is added, children frequently acquire it or some proportion of it without direct instruction (Doyle, P. M., Gast, D. L., Wolery, M., Ault, M. J., & Farmer, J. A., 1990; Gast, Doyle, Wolery, Ault, & Farmer, 1991; Shelton, Gast, Wolery, & Winterling, 1991; Stinson, Gast, Wolery, & Collins, 1991; Wolery, Cybriwsky, Gast, & Boyle-Gast, 1991; Wolery, Doyle, Ault, Gast, Meyer & Stinson, 1991). However, this research has occurred primarily with older children (i.e., elementary and secondary students in special education programs) and has been conducted in the context of

1:1 or small-group direct instructional sessions.

The purpose of the present study was to assess the effects of providing a small number of transition-based teaching trials along with instructive feedback. Three questions were asked: (a) Will preschoolers with hearing impairments acquire preacademic behaviors when taught through a small number of transition-based teaching trials; (b) will they acquire extra information provided in praise statements following correct responses (i.e., through instructive feedback) in transition-based teaching trials; and (c) will they generalize these responses to other materials?

Method

Subjects

Three male students (3 years 9 months to 4 years 5 months) were selected from a classroom for preschoolers with language delays and/or hearing impairments. They were each identified as hearing impaired and were aided with a Phonic ear. The adults in the classroom wore microphones to assist in communication. Two of the children used total communication. One was verbal and used sign occasionally. None of the students evidenced any visual impairments.

Alan, a caucasian male from a lower income home with a single parent receiving AFDC, was 4-years-0-months at the onset of the study with the following scores on the Learning Accomplishment Profile-Revised (LAP-R) (Sanford & Zelman, 1981) given at 38 months. He was above his chronological age in gross motor (48 months), and fine motor skills (42 months). He was age-appropriate in pre-writing (38 months) and in self help skills (40 months). His cognitive and personal/social skills were both at 30 months or mildly delayed but the examiner commented that it was due to expressive language delays. He was diagnosed as having a severe to profound hearing impairment bilaterally. He had normal tympanic membrane mobility. At the time of testing, he was completely non-verbal. In the preschool class, he was learning to use English sign language and had begun to evidence some vocalizations accompanied by sign.

William, a 3-year-9-month old caucasian male from a lower middle income home, was diagnosed with Sathre-Chotzen syndrome or acrocephalosyndactyly (Type III), a heritable condition that results in facial asymmetry, hypertelorism, small ears, cutaneous syndactyly, short clavicles, low motor tone, and possibly mental retardation. On the Peabody Picture Vocabulary Test (Dunn & Dunn, 1981), William had a 1-year delay when he was 3 1/2 years old yielding a mental age of 2 1/2 and a language quotient of 71. On the LAP-R, he had an 18-month delay in gross motor, a 14-month delay in fine motor and self help skills, and a 10-month delay in cognitive abilities. He was age-appropriate on the social and emotional scale. He was also given the Preschool Language Scale (Zimmerman, Steiner, & Evatt, 1969), and the Khan Lewis Phonological Analysis (Khan & Lewis, 1986). His receptive language was appropriate, his expressive language was also at the 3.5 year level and his phonological abilities were at the 4-year level. He showed an awareness of sounds without a hearing aid, could discriminate between linguistic and non-linguistic sounds, and could follow simple auditory directions. He wore a Phonic Ear auditory trainer to compensate for a diagnosed mild to moderate upward sloping conductive bilateral hearing impairment.

Joe, a 4-year-5-month old Afro-American male from a lower income home with a single parent receiving AFDC, was diagnosed with Treacher Collins syndrome with bilateral atresia and a cleft of the secondary palate. He evidenced bilateral microtia with absence of external auditory canals. In addition, he had an under-developed jaw, missing teeth, and an absence of zygomatic arches. He wore a band type bone conductor hearing aid. He was diagnosed with a severe to profound hearing loss. He could vocalize but was non-verbal. At a chronological age of 16 months, he was given the Bayley Scales of Infant Development (Bayley, 1969). He scored a mental age equivalent of 13 months and a motor age of 12 months showing a mild delay. At 4 years (48 months) he was given the Preschool Language Scale (Zimmerman, et al., 1969). His receptive language was at 2 years, 6 months and his expressive language was at the 1 year 9 month level. On the LAP-R (given at 49 months of age), his gross motor skills and self help skills were age appropriate. Other scores were: fine motor 40 months, personal/social 36 months, pre-writing 34 months, and cognitive 33 months.

Setting

The setting was a preschool classroom (6.4 m x 9.7 m) for children with disabilities containing 13 students and 2 professionals. A volunteer was frequently present. Instruction (transition-based teaching) was conducted by the teachers in the classroom during transitions between activities. These occurred throughout the classroom at various activity areas. Generalization and instructive feedback probes and daily probe sessions were conducted by the investigator in the students' classroom at either the activity table or the speech table (.9 m x 1.8 m). The students sat facing the investigator with their backs to the classroom. Students not involved in the study participated in regular classroom activities with the teachers or the classroom volunteer.

Materials

Three sets of materials were used. First, during training and daily probe trials, colored shapes were hand drawn on white cards (13 cm x 20 cm). These shapes were large, nearly covered the card, and were colored with crayon. Second, for instructive feedback probes, colored circles were hand drawn on white cards (13 cm x 20 cm). The circles were colored the same as the training and daily probe shapes. A red and a blue circle (colors known to the three subjects) were used as "warm-up" stimuli for instructive feedback probes. Third, for generalization probes, line drawings of the target shapes in black ink on white cards (13 cm x 20 cm) were used. The shapes were much smaller than those used in the training and daily probe trials. A variety of edibles (pretzels, M & M's, small cookies, raisins, peanuts, etc.) were used as reinforcers at the conclusion of all probe sessions non-contingent on performance.

Procedures

General procedures. Initially, children were screened to identify 6 shapes and 6 colors that were unknown to all children. The students were then taught to wait for teacher assistance (the prompt) when faced with an unknown stimuli. Upon identification of these instructional stimuli, the investigator implemented generalization probes and instructive feedback behavior probes. The six shapes and colors were then divided into three pairs (i.e., two shapes each of a different color), and one pair was taught to criterion before instruction on the next pair was implemented. Two classroom professionals (a special education teacher and a speech pathologist) taught each shape using constant time delay, implemented in a transition-based teaching format, and presented the colors through instructive feedback. During transitions, they presented six trials per day to each child, three trials on one behavior and three trials on the other behavior. These trials occurred only during transitions from one activity to another. The investigator conducted individual daily probe sessions (4 trials, 2 per shape) with each child. This continued with each pair of shapes until criterion level performance was established (i.e., three consecutive daily probe sessions with 100% correct responses). A summary of the conditions is provided in Table 1.

Insert Table 1 about here

Generalization probe procedures. Generalization probe sessions occurred prior to instruction on any pair of stimuli and when students achieved criterion on each pair. In each probe condition, four sessions were conducted over three days. Shapes and colors not yet introduced in training sessions were probed to assure that they were still unknown. Shapes and colors that had already been taught to criterion also were probed to assess maintenance of skills. The stimuli were presented in a randomized order.

In each session, the child was asked to name expressively the shape drawn in black ink on white cards. He had not seen these stimuli in training. He was given an attentional cue ("Ready?" or "Look" etc.) and when he looked, he was shown the card and asked, verbally and in English sign language, "What is this?" or "What shape is this?" The investigator then provided a response interval of 4 seconds (counting silently, "1001, 1002, 1003, 1004"). If the child answered correctly, he was praised. If there was no response at the end of 4 seconds or if there was an error, he was given a non-judgmental response such as "Ok" or "We'll learn that later." After an intertrial interval of 2 to 5 seconds, the next trial was presented. Each session consisted of 12 trials with two trials for each of the six shapes.

Instructive feedback probe procedures. The instructive feedback probe sessions were conducted to assess children's acquisition of the extra information (i.e., colors of shapes) presented in the consequent events of transition-based teaching trials. They were conducted on the same days as the instructive feedback probes but in different sessions. The procedures were identical to those used in the generalization probes, except that the stimuli were cards with one large circle, each colored a different color.

Daily probe procedures. Daily probes were conducted during training to assess students' acquisition of the skill of expressively naming the shapes being taught using the training stimuli. The daily probes were conducted in a 1:1 arrangement with one session per day per student. The materials used were identical to those used in the training sessions (i.e., colored shapes). The students received 4 trials per session, two per shape being trained.

The trial sequence was identical to that used in the generalization probes with two exceptions. The training materials (colored shapes) were used. Also, regardless of the response, the student received a non-committal "OK" and the next trial was presented. The instructive feedback information (the color of the shape) was not assessed during daily probe sessions.

Instructional procedures. The existing transition procedures in the classroom involved calling the children one by one to line up to move to other areas or activities. A constant time delay procedure implemented in a transition-based teaching format was used. Constant time delay includes two types of trials: 0-second trials and delay trials (Wolery, Ault, & Doyle, 1992). The 0-second trials involve presentation of the task direction immediately followed by a controlling prompt (i.e., one that will ensure that the child responds correctly). In this study, at the time of a transition, the teacher called for the child to come near to her, said the child's name and asked the child to look. When the child looked, the teacher showed the stimulus card and said/signed, "What shape is this?" and immediately provided a model (signed and verbal) of the correct response. The child then imitated the teacher's model or was guided to verbally and/or manually to say/sign the name of the shape. The teacher praised the child and said, "This (shape name) is (color name)." This constituted the presentation of the instructive feedback, and no response was required from the child. The child then continued with the transition.

For delay trials, the same procedures were used; however, after presentation of the task direction, a 4-second response interval was provided before the prompt was delivered. During this time, the child could respond or wait for the controlling prompt, verbal and signed model of the name of the shape. If the student waited, the teacher modelled the correct response. If the student answered incorrectly, the teacher modelled the correct response. If the student responded correctly, he was praised. For each correct trial, before or after the controlling prompt, the teacher praised the child and added, "The (shape name) is (color name)", telling the student the color of the stimulus. Each trial lasted approximately 5 seconds. Five types of responses were possible. The students could (a) answer correctly before the prompt--unprompted corrects, (b) answer correctly after the prompt--prompted corrects, (c) answer incorrectly before the prompt--unprompted errors, (d) answer incorrectly after the prompt--prompted errors, or (e) they could give no response.

For one student, a short series of massed-trial, constant time delay training was introduced following training on the second pair of behaviors. Joe was correctly signing the shapes during the daily probes, but, since he was also giving the colors, it was unclear whether he knew to separate signs for the shape and for the color. He was given 5 sessions of training on shape names (for Set II only) that included 10 trials (5 for each stimuli). He reached 100% correct responding after 3 sessions (one at 0-second) and was given 2 sessions at 100%. He was again assessed for generalization and to determine that the third pair of stimuli were still unknown.

Experimental Design

A multiple probe design (Tawney & Gast, 1984) across behaviors (pairs of colored shapes) was used to evaluate the effectiveness of time delay with trials delivered within a transition-based teaching format and the effectiveness of instructive feedback. Initial probes established a baseline. Daily probes monitored the learning of the directly taught behaviors and subsequent probe conditions monitored generalization, maintenance, and amount of learning of the instructive feedback behaviors.

Reliability

Reliability across the procedures and for the dependent measure were taken to ensure both dependent measure and procedural fidelity (Billingsley, White, & Munson, 1980). These measures were collected during the same sessions. The following behaviors were checked for procedural reliability: ensuring student attention, giving task directions, waiting the appropriate response interval, giving the correct information in instructive feedback, giving a verbal response, and waiting the correct intertrial interval.

Results

Reliability

Reliability assessments were conducted during 19% of the daily probe sessions for William, 13.3% of the daily probe sessions for Joe, and 14.2% of the daily probe sessions for Alan. Estimates were taken during 12.5% of the generalization and instructive feedback behavior probe sessions for William and Alan and 6.25% for Joe. Interobserver agreement percentages were calculated using the point by point method (number of agreements divided by number of agreements plus disagreements multiplied by 100). The mean percentage of agreements of student responding during daily probe conditions was 100% across all students and 99.16% (range 91.6%-100.0%) across all students during generalization and instructive feedback behavior probe conditions. The mean percentage of agreement on investigator's fidelity (procedural reliability) was 100.0% on all behaviors during both daily, generalization, and instructive feedback probe sessions.

Effectiveness

The use of constant time delay when implemented during transitions (i.e., transition-based teaching) was effective in teaching the three children expressive naming of the target shapes. All three students learned six shapes to the pre-set criterion level (i.e., 100% correct responding for 3 consecutive days) with one exception. On the final pair of shapes, Joe was given only 2 days of 100% correct performance before implementation of the generalization and instructive feedback probe conditions. This change was made because of an impending absence due to planned surgery.

The number of daily probes through criterion are shown in Table 2. The number of days of training included each of the daily probe days plus one day of 0-second training prior to implementing daily probes. In addition, there were 4 days of investigator absence (3 for Pair One and 1 for Pair Two). On these days, daily probes were not conducted but instruction proceeded. For Pair III, Alan was absent for the first day of instruction. To reach criterion, students ranged from 3 to 12 days of training per shape pair. Across subjects, Pair I required 11 to 12 days, Pair II required 8 to 11 days, and Pair III required 3 to 7 days. Each day of training included 6 individual trials (3 trials per shape in the pair) per child; each trial lasted approximately 5 seconds. Thus, children acquired each shape with relatively few trials (range of 9 to 36 total trials per shape) and with those trials distributed across transitions of the day and across 4 months of instruction.

Insert Table 2 about here

Daily probe sessions were used to monitor learning, and these sessions may have contributed to acquisition of the responses. However, no assistance (i.e., prompts), no reinforcement of correct responses, and no correction of error responses occurred in those sessions. These sessions were brief and averaged about 43.5 seconds per day per child.

Generalization

All three students generalized the names of shapes from the colored stimuli to the smaller black and white line drawings of shapes in the generalization probe sessions. As shown in Table 3, no child responded correctly to any generalization shapes until after receiving training. After training, the percent of correct responses in generalization sessions increased but did not reach 100% in most cases.

Insert Table 3 about here

Acquisition of Colors (Instructive Feedback Stimuli)

The effects of adding additional information (i.e., color names) to the consequent events of the constant time delay procedure when implemented during transitions were assessed through probe conditions before and after each training condition. None of the children responded correctly to any color before training was implemented on the shape pair containing those colors. After training, however, the percent of correct responses increased for all subjects on all colors except for Alan on the second pair of colors and Joe on the final pair of colors. These data indicate that in most cases, the addition of the color name in the praise statements following correct naming of the shape during transition-based teaching trials resulted in slight increases in the naming of colors.

Insert Table 4 about here

Discussion

The purposes of this study were to determine whether preschoolers with hearing impairments would acquire shape names that were taught with constant time delay only during transitions between in-class activities, whether generalization would occur across materials and persons, and whether additional information (i.e., color names) inserted in praise statements for correct responses would be acquired. The results suggest the following findings. First, constant time delay implemented during transition-based teaching trials was effective in establishing criterion level responding on all target shapes (i.e., 6 shape names) with all children. This finding extends previous research with constant time delay that indicated it was effective with preschoolers in 1:1 instructional sessions (Doyle, Wolery, Gast, Ault, & Wiley, 1990) and in small group arrangements (Cybriwsky, Wolery, & Gast, 1990). Also, it replicates one earlier study (Ouellette, 1989) indicating that constant time delay was effective in massed trial sessions with preschoolers who had hearing impairments.

Second, this study replicates one other investigation (Wolery et al., in press) indicating that implementing single trials during transitions between in-class activities would result in acquisition of preacademic behaviors. This supports the contention that transitions may present useful instructional opportunities. As with the Wolery et al. (in press) investigation, the procedures used in this study resulted in rapid acquisition of the target responses. Specifically, each child received 6 trials per day, 3 trials for each shape of the pair receiving instruction. Although the duration of all trials was not measured, a sampling indicated that they averaged about 5 seconds and rarely required as much as 10 seconds. Thus, children received about 30 seconds of instruction per day with the most being about 1 minute per day. As discussed, children acquired the responses for each pair in 3 to 12 days of instruction. Thus, children acquired the responses in few trials and minutes of instruction.

A common objection to transition-based teaching is that it is too demanding of teachers. However, this study was designed to minimize those demands as compared to the earlier study of transition-based teaching (i.e., Wolery, et al., in press). All children were taught the same behaviors; thus, staff members were not required to manage different stimulus materials for each child. Since two professionals worked in the classroom and implemented the transition-based trials, each delivered one stimulus (e.g., the teacher implemented the diamond trials and the speech pathologist implemented the oval trials). Also, the stimulus materials were placed in the classroom near to where regular transitions occurred. This reduced the effort involved in retrieving the materials needed to conduct a trial. The instructive feedback information was added to both the praise and correction statements following a trial, reducing the decision making process needed during a trial. Further, the investigator conducted daily probes to monitor children's learning; thus, staff members were not required to collect data during the transitions. Finally, since few trials occurred per day, if the staff were unable to implement a trial in a given transition, it could be "made up" later in the day at another transition.

Interviews with the teachers at the end of the study indicated that the technique was not disruptive and that it was possible to use within the context of the school day. They indicated that teaching skills that did not involve physical materials would have been easier to use. While these were generally positive comments, it is our opinion that subjective evaluations may be suspect because they do not reflect future adoption of the technique. Therefore, several months later, in the subsequent school year, the teachers were contacted again to determine their level of satisfaction with the procedure and to assess whether they had incorporated it into their classroom routines. The special education teacher had used transition-based teaching to review material that had been introduced in circle time and in small group time. She still reported that she felt it was a good technique for the introduction of material. The speech pathologist was teaching in a different center in the subsequent year. She reported that she also reviewed lessons during transitions specifically when the children were leaving the class to return home. She felt that the timing of this transition may help in the generalization and use of material from the class setting to the home setting. She also reported that she used instructive feedback in response to children's speech but that she had not selected specific stimuli to teach. She modeled an expansion of their sentences as they were moving from activity to activity during the day.

Third, as shown in Table 3, children generalized the responses to different materials when tested by another person. This generalization was not perfect, but was higher than pre-instruction performance and was maintained throughout the study. Multiple exemplars of the shapes (varying the size, etc.) or embedding review trials into other activities during the day may have helped increase performance on generalization measures.

Fourth, as shown in Table 4, all children acquired some of the additional information (i.e., color names) that was presented through instructive feedback. They did not receive direct instruction on these responses. Previous research had documented that using instructive feedback during 1:1 and small group direct instructional sessions would result in acquisition of some of that information (Cybriwsky et al., 1990; Shelton et al., 1991; Stinson et al., 1991; Wolery, Doyle, et al., 1991). However, no study has previously evaluated the use of instructive feedback during transition-based trials or in trials distributed throughout the day. Although increases in the percent of correct responses on the instructive feedback stimuli occurred for all subjects, it was neither complete nor consistent and occurred at lower levels than in other studies. Explanations for this may have been children's sensory impairments, the relatively small number of total trials, the distributed nature of the trials, and/or anticipation of continuing the transition. Interestingly, each of the children was observed displaying the color names during training or other conditions. Joe was seen leaving some of the transition-based instructional trials signing "pink," "black," and "purple." He also responded with a color name when asked "What shape?" during post-testing. William responded to daily probes in the last set of shapes by adding "... and it's black." and "... and it's white" to the shapes, but he did not completely generalize that knowledge to the probe stimuli, only responding correctly to 50% of the white circles and 25% of the black circles when asked "What color?" Alan also signed the colors "black" and "white" during daily probes on the third set of shapes; however, during the instructive feedback probe conditions after training, he responded correctly to 37.5% of the white circles and 0% of the black circles.

Based on these findings and those of other studies, teachers are encouraged to consider using transition-based teaching procedures when they want to teach discrete responses to young children. When doing so, they should employ the constant time delay procedure in those trials and should add extra information to the feedback statements for correct responses. Although they can monitor children's learning during instruction, this study demonstrates that brief daily probes (e.g., less than 1 minute per day) also can be used to monitor acquisition of behaviors taught during transitions. The choice of transitions in which to implement the technique has not been systematically investigated. Teachers should choose those in which the children are transitioning independently, in which behavior management is not a factor, and in which the duration of the transition is within a reasonable time period. Moving to a preferred activity may enhance the effect. Appropriate tasks for teaching in transitions include those that require a response of short duration. Other factors such as curriculum areas, relatedness and types of presentation have not been fully investigated.

This study raises some interesting questions about instruction of young children with disabilities. The results demonstrated that children with hearing impairments could acquire the targeted responses taught during transitions. Future research should investigate the possibility of providing a single trial to a small group of children at the transition time (e.g. with a choral response from the children). This would decrease some of the demands on teachers in implementing the transition-based trials. Further, in this study, the behaviors being taught were probed daily to monitor learning. It is unclear whether and how that probing influenced acquisition and whether an intermittent schedule (e.g., every other day) of assessment would be adequate.

In the current study, the children learned some of the extra information added to the praise statements after correct responses; however, the amount of learning was variable and the stimulus control was weak. It is unclear whether greater learning of the extra information would have occurred by subjects who did not have sensory impairments, or whether changing the color of the two shapes (e.g., one day an oval would be pink and the diamond brown and the next day the oval would be brown and the diamond pink) across days would have promoted more attention and thus more learning to those stimuli. These are issues for further research. Also, future research should examine what types of extra information are most readily learned in this manner. Finally, the effects of intermittent probes on the extra information should be assessed. It is possible that children learned less of this information because they were not required to demonstrate that they had learned it.

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Table 1

Description of Experimental Conditions and Measures

Condition Purpose	Procedural Variables
Screening To identify 6 shapes (target stimuli) and 6 colors (instructive feedback stimuli) all unknown to all children.	Setting: 1:1 arrangement Task Direction: "What shape/color?" Behavior: expressive naming of shapes and colors Consequent Events: corrects praised; error responses were ignored Occurred prior to other conditions
Wait Training To teach students to wait for teacher assistance (prompt) when faced with unknown stimuli.	Setting: 1:1 arrangement Materials: non-sense designs Task Direction: "What's this?" Behavior: waiting for teacher prompt 8-10 trials/session. 2-3 sessions; Consequent Events: waits praised; and error responses - "Wait and I will tell you." Occurred after screening and before other conditions
Generalization Probes To assess children's expressive naming of shapes in black line drawings on white cards (i.e., generalization of target behaviors)	Setting: 1:1 arrangement All 6 shapes measured Task Direction: "What shape is this?" Behavior: expressive naming of shapes, 12 trials/session, 2 trials per shape, 2-4 sessions Consequent Events: corrects received praise and an edible; errors were ignored Occurred before implementation of all instructional conditions and after criterion on each set of shapes

Table continues

Table 1 (continued)

Condition Purpose	Procedural Variables
Instructive Feedback Probes To assess children's expressive naming of colors in circles on white cards (i.e., acquisition of extra information).	Setting: 1;1 arrangement All 6 colors measured Task Direction: "What color is this?" Behavior: expressive naming of colors, 12 trials/session, 2 trials per color, 2-4 session Consequent Events: corrects received praise and an edible; errors were ignored Occurred with generalization probes
Transition-based Teaching To provide instruction using transition-based teaching with shapes as the target stimuli and colors as the instructive feedback behaviors.	Setting: in-class transitions 2 shapes per condition/3 conditions Task Direction: "What shape is this?" Behavior: expressive naming: shapes Procedure: constant time delay, 2 sessions of 0-second trials, and subsequent sessions of 4-second trials, 3 trials per stimulus per day delivered during transitions Consequent Events: corrects lead to praise, instructive feedback (color of stimulus), and transition continues; errors lead to model of correct response and continuation of transition
Daily Probes To assess children's acquisition of shape names during transition-based teaching condition	Setting: 1:1 arrangement 2 shapes per condition/3 conditions Task Direction: "What shape is this?" Behavior: expressive naming of shapes: 4 trials, 2 per stimuli Consequent Events: corrects/errors resulted in a noncommittal "O.K." Occurred daily during transition-based teaching conditions

Table 2

Number of Sessions of Daily Probes Through Criterion

Student	Probe I	Probe II	Probe III
William	8	9	4
Alan	8	7	7
Joe	7	6	2

Table 3

Percentages for generalization probe sessions for shapes*

Shapes	I	II	III	IIIa	IV	Post Test
William						
Diamond	0.0	87.5	37.5	--	50.0	100.0
Oval	0.0	0.0	12.5	--	25.0	0.0
Rectangle	0.0	0.0	100.0	--	75.0	100.0
Cross	0.0	0.0	25.0	--	100.0	0.0
Cube	0.0	0.0	0.0	--	0.0	100.0
X	0.0	0.0	0.0	--	25.0	0.0
Alan						
Diamond	0.0	75.0	37.5	--	100.0	100.0
Oval	0.0	87.5	62.5	--	37.5	100.0
Rectangle	0.0	0.0	62.5	--	50.0	0.0
Cross	0.0	0.0	100.0	--	87.5	100.0
Cube	0.0	0.0	0.0	--	100.0	100.0
X	0.0	0.0	0.0	--	0.0	0.0
Joe						
Diamond	0.0	62.5	62.5	25.0	0.0	0.0
Oval	0.0	75.0	37.5	0.0	0.0	0.0
Rectangle	0.0	0.0	25.0	75.0	100.0	100.0
Cross	0.0	0.0	50.0	100.0	100.0	100.0
Cube	0.0	0.0	0.0	0.0	100.0	100.0
X	0.0	0.0	0.0	0.0	50.0	100.0

*Solid lines represent the occurrence of training.

Table 4

Percentage of Correct Responses on Instructive Feedback Information (Color)[a]

Colors	Probes I	II	III	IIIa	IV
William					
Pink	0.0	0.0	12.5	--	0.0
Brown	0.0	62.5	100.0	--	100.0
Gray	0.0	0.0	12.5	--	0.0
Purple	0.0	0.0	0.0	--	25.0
Black	0.0	0.0	0.0	--	25.0
White	0.0	0.0	0.0	--	50.0
Alan					
Pink	0.0	12.5	0.0	--	0.0
Brown	0.0	12.5	87.5		87.5
Gray	0.0	0.0	0.0	--	0.0
Purple	0.0	0.0	0.0	--	0.0
Black	0.0	0.0	0.0	--	0.0
White	0.0	0.0	0.0	--	37.5
Joe					
Pink	0.0	50.0	0.0	0.0	0.0
Brown	0.0	25.0	12.5	25.0	25.0
Gray	0.0	0.0	12.5	0.0	50.0
Purple	0.0	0.0	0.0	0.0	0.0
Black	0.0	0.0	0.0	0.0	0.0
White	0.0	0.0	0.0	0.0	0.0

[a] Solid lines represent the occurrence of training.

Appendix G

Stimulus Equivalence Established Through Instructive Feedback

Stimulus Equivalence Established
Through Instructive Feedback

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Abstract

Three studies were conducted to determine whether a stimulus class would emerge as a result of one conditional discrimination training (implemented with constant time delay) augmented with instructive feedback. Five middle school-aged students enrolled in a class for emotional support participated in the studies. The students were taught to identify fractions and their equivalents in lowest form and multiplied by factors. The results indicated that, after modifications in the placement of the lowest form of the fraction, the students were able to form a stimulus class. This was accomplished with minimal number of trials and training time, near errorless learning, and in a classroom setting with group instruction. Repeated probing strengthened the relationships.

Stimulus Equivalence Established Through Instructive Feedback

An equivalence class of three or more stimuli can be formed by training all the relationships contained within the class. However, many investigators have found that not all the relationships in a class need to be trained for an equivalence class to emerge (Sidman, 1971, Sidman & Tailby, 1982; Fields, Verhave, & Fath, 1984; Spradlin, Cotter, & Baxley, 1973). For example, if A=B and B=C, then subjects may be able to identify C as an equivalent stimulus if they are shown A. Furthermore, if a strong stimulus class has been formed through training A=B and B=C, then subjects will be able to identify A if C is presented, to identify B if A is presented, and to identify B if C is presented.

Training to establish such a stimulus class typically consists of training pairs of stimuli using a conventional match-to-sample procedure training at least two classes of stimuli concurrently (Fields & Verhave, 1987), and using unidirectional training (O'Mara, 1991). Testing which follows the training uses a match-to-sample format to present the training stimuli in pairs that were never seen together in training and that were seen in another order. To be accepted as a stimulus class, the subject must show three conditions (Sidman & Tailby, 1982): (a) reflexivity--the ability to match each stimulus to itself without prior instruction; (b) symmetry--the ability to match pairs that have been trained in reverse temporal order; and (c) transitivity--the ability to identify a third conditional relation between the sample of the first relation and the correct comparison of the second. This must emerge without reinforcement or other training or instructions (Harrison & Green, 1990).

Training to form stimulus classes has generally been conducted in a train-test-train-test paradigm with conditional discrimination training given individually. The subject acquires the relationships through interactions with a teaching machine (Spradlin et al., 1973), a computer (Fields, Adams, Verhave, & Newman, 1990), or a teacher (Osborne & Gatch, 1989). The training in such experimental studies has been conducted on an individual basis. No studies were found in which the training was conducted in a group.

Theoretically, the minimal conditions needed to link all stimuli within a class is the establishment of (n-1) two term relations by direct training, providing each element in the class is used once (Fields et al., 1984). O'Mara (1991) concurs, stating that the number of "links" (conditional relations) required is n-1, otherwise, one of the stimuli will be omitted.

Several studies of direct instruction with learners who have disabilities have focused on a procedure called instructive feedback (Gast, Ault, Wolery, Doyle, & Baklarz, 1991; Wolery, Cybriwsky, Gast, & Boyle-Gast, 1991; Wolery, Doyle, et al., 1991; Wolery, Holcombe, Werts, & Cipolloni, in press). In these studies, trials are operationalized as follows: The teacher secures the student's attention, presents the target stimulus and task direction (i.e., often "What is this?"), and provides a response interval. If the student responds correctly, the teacher praises or otherwise reinforces the child and simultaneously presents a second stimulus (i.e., instructive feedback). The student is not expected to respond to this second stimulus and is not reinforced for doing so. For example, the student is taught to read a printed word, and during the delivery of the consequent events for correct responses the definition of the word is supplied (i.e., instructive feedback).

When this arrangement is used, students acquire the target relation (e.g., reading the word) and often acquire some if not all the relations presented through instructive feedback (e.g., they are able to state the definition of the word). Wolery, Werts, Holcombe, Billings, and Vassilaros (in press) investigated the possibility that students would acquire two pieces of information presented as instructive feedback. They taught children to name the values of various arrays of coins, and through instructive feedback, presented the corresponding numeral and corresponding number word. They compared two conditions: presentation of the corresponding numeral and corresponding number word on all trials through instructive feedback (called simultaneous condition), and presentation of the corresponding numeral on half the trials and the corresponding number word on the other half of the trials through instructive feedback (called alternating condition). The results indicted that no substantial differences occurred in the amount of instructive feedback information learned. Students were able to match the target stimulus to the corresponding numerals and number words for both the simultaneous and alternating conditions. The instructive feedback stimuli in the alternating condition had never been seen together during instruction. However, tests for reflexivity, symmetry, and transitivity were not conducted; therefore, no definitive statements could be made about the formation of stimulus classes. However, the students' ability to match the instructive feedback stimuli from the alternating condition raised the question of whether stimulus classes could be established through instructive feedback.

Thus, the focus of this experiment was to determine whether stimulus equivalence or the formation of an equivalence class could be established in one training series by using instructive feedback: conducting target training with direct instruction on only one relationship while presenting two other relationships via instructive feedback. Additionally, the training was conducted in a group situation in a classroom. The testing on all relationships was conducted for each student prior to training and after the students reached the criterion level on the target behavior. Testing was kept to a minimum to counteract the effect of emergence of stimulus classes or stimulus equivalence during testing so that we could determine whether instructive feedback training was the agent for establishing equivalence.

Experiment I

Methods

Subjects

Five subjects enrolled in a suburban middle school served as subjects. They were enrolled in seventh grade and were receiving special education services in a classroom for emotional support. All five were diagnosed as Socially and Emotionally Disturbed. All were caucasian and were from middle income homes. Four of the five were from single-parent homes.

Three of the five subjects had a deficit area in Arithmetic on the Wide Range Achievement Test (WRAT) (Jastak & Wilkinson, 1984), 6th percentile for Emma and Ken and 12th percentile for Teddy. Drew scored a scaled score of 7 in arithmetic on the Wechsler Intelligence Scale for Children-Revised (WISC-R) (Wechsler, 1974). Barry was at grade level for all academic subjects. In the language arts areas, three students, Emma, Teddy and Ken, scored at average or better on the WRAT. Drew was given the Peabody

Individual Achievement Test-Revised (Dunn & Markwardt, 1988), and scored in the average range in reading comprehension. Demographic information on subjects is shown in Table 1.

Insert Table 1 about here

Setting

Instructional sessions were conducted by the special education teacher in the classroom (5.6 m x 8.5 m). Typically, two to three other students were also in the room and receiving instruction from a classroom assistant during the experimental sessions. The training sessions and the probe sessions took place at a table (1.5 m x 1 m) at the front of the classroom. Students sat facing the teacher with their backs to the classroom. Probe sessions also were conducted by the teacher at the same table and were conducted individually.

Materials

Fractions printed in black numerals (Universal type, 36 point) on white cards (7 cm x 13 cm) were used for instruction. The target stimuli were fractions that were not in lowest form and the instructive feedback stimuli, printed on the back of the card in the same type were equivalent, but different forms, of those fractions. These stimuli are shown in Table 2.

Insert Table 2 about here

Four fractions printed in black, 36 point Universal type on a standard sheet of white paper (21.5 cm x 28 cm) were displayed in the four quadrants of the paper presented horizontally. The four choices consisted of the correct answer (B1), the equivalent fraction for the other target in the training (B2), a fraction consisting of the numerator of B1 and the denominator of B2, and fraction consisting of the numerator of B2 and the denominator of B1. In the two cases that this resulted in a distractor fraction equaling 1, the digits of the denominators were reversed, resulting in the use of all digits in the fractions an equal number of times equating the positive and negative valences of the choices. One sheet of fractions was used for 5 trials and then a new sheet with the fractions in different positions was placed on the table in front of the students. If there was only one student in the group. The sheet was rotated after two trials. Session duration was timed with a stopwatch.

Materials used in the probe sessions were similar to those used in training. The stimulus cards had a fraction on only one side of each card, either A1, B1, C1, or D1. Students pointed to their choices on sheets of paper with four fractions arrayed and selected in the same manner as those for the training sessions. The probe sessions included fractions from all three planned experiments.

Reinforcers were used in each training session. For the first two training sessions, small crackers were used. At the request of the students, the reinforcer was changed to gum. This was used for the remainder of the sessions through all three experiments.

Procedures

General procedures. Initially, all students were screened to identify unknown stimuli. Six sets of 4 equivalent fractions were identified as behaviors for instruction and were assigned to each experiment. Following identification of fractions, pretest measures were implemented. Tests for reflexivity were given prior to the first training. Symmetry and transitive relationships were intermixed and tested over three days. Three target probes were administered during the same three day period but in separate sessions. Instruction began for Experiment I when all children finished probe sessions. One training session was conducted daily, generally five days per week. Two target stimuli were taught in the sessions. All five students were taught the same stimuli using a constant time delay technique with instructive feedback.

Probe condition procedures. Probes to evaluate reflexivity (Sidman & Tailby, 1982) were conducted individually by showing the students a fraction on a card (7 cm x 13 cm), and simultaneously displaying an array of six fractions, with one of the 6 being identical to the sample, on an sheet of paper (21.5 cm x 28 cm). The papers were clipped into a three ring binder. One page was used per trial. All the fractions to be used in the three experiments were evaluated in one session with one presentation each of the 24 fractions that were originally identified for instruction.

A target check probe was implemented after training was completed and prior to full probing. Four trials (2 per stimuli in the training set) using just the target behaviors (A1=B1 and A2=B2) were given individually to the student. If the performance was at 100% correct responding, the full probes were implemented.

Individual full probe sessions were conducted to evaluate acquisition of target behaviors (A=B relationships), behaviors presented in instructive feedback (B=C, and B=D), and the relationships expected due to symmetry (B=A, C=B, D=B, D=C, C=A, and D=A) and transitivity (C=D, A=C, A=D). These took place prior to training, and following each experiment. Instructive feedback, symmetry, and transitive probe sessions were conducted over three days and included 1 trial for each behavior per relationship in other experiments (44 trials) and 3 trials for each behavior in the currently trained set (66 trials). One trial per target relationship was given in each probe session. Three target probe sessions were given for a total of 72 target trials (24 for each experimental set).

The notebook containing the sheets of comparison stimuli was placed on the table in front of the subject. Each trial began with the presentation of a fraction on the stimulus card (7 cm x 13 cm). The teacher held the card so that it could be seen, gave an attending cue, ("Look" or "Ready?" or said the name of the student), and then gave the task direction, "What fraction is equal to this fraction?" The subject was given 3 seconds to respond and was instructed to "Guess if you don't know." The subject responded by pointing to the choice. Non-committal feedback was given intermittently. During the intertrial interval, the subject's choice was recorded by the teacher, the next sheet of comparison stimuli was shown and the next card presented.

Instructional procedures. Constant time delay was used to teach the equivalent fractions A1 = B1 and A2 = B2 for Experiment I (shown in Table 2). Following a correct response either before or after the controlling prompt, the C stimuli were shown on half the trials and the D stimuli on the other half (i.e., for A1=B1 half the trials resulted in the presentation of C1 and the other half with D1; for A2=B2 half resulted in the presentation of C2 and half with the presentation of D2). The experiment is diagrammed in Figure 1.

Insert Figure 1 about here

In a 20 trial session, each subject was given 4 trials, (2 with A1 = B1 and 2 with A2 = B2) and saw C1, C2, D1, and D2 in the instructive feedback. Order of trial presentation was random. Each instructive feedback stimuli was presented once to each subject in each session. In addition, each subject had the opportunity to observe the responses to target stimuli and the instructive feedback for the 16 additional trials presented to the other subjects in the group. As a student reached criterion level responding and was placed into probe conditions or if a student was absent, the number of trials for the group decreased by four trials. Attention to trials presented to the other students was neither required nor reinforced, and no data on attending behavior were collected.

Constant time delay includes two types of trials: 0-second and delay trials. The 0-second trials involve presentation of the task direction immediately followed by a controlling prompt (i.e., one that will ensure that the child responds correctly). In this study, the teacher provided the four choices of fractions for the response, ensured that the student was attending, presented the sample card and the task direction ("What is the lowest form of this fraction?), and immediately followed the question by pointing to the correct response choice and providing a verbal model. The student then imitated both the pointing to the correct choice and the verbal response. If a student did not point but gave the verbal response only, the teacher gave the instructions to point. If the student pointed to the correct choice but omitted the verbal model, no correction was given. The pointing response was scored in the event of a difference in verbal and pointing response. If the student responded correctly to the target trial, the teacher praised the student and delivered the reinforcer. The teacher then turned the sample card around, showing the back of the stimuli card and said, "This also equals that fraction." No response was required from the student and no consequence was attached to the instructive feedback. Since the "A" stimulus was on one side of the stimulus card and the "C" or "D" on the other side, these stimuli were not seen together.

Beginning with the second session, delay trials (3 seconds) were introduced. The delay trials were identical to the 0-second trials with two exceptions. First, a 3-second response interval was inserted after the task direction and before the controlling prompt. Second, at the beginning of the session, the teacher said, "If you know the answer, point to the correct choice. If you do not know, wait, and I will show you." Consequences for correct responses were identical to those for the 0-second trials. If there was no response during the response interval, the teacher modeled the correct response and allowed the student to imitate. If there was an error, the trial was terminated. Instructive feedback (turning the sample card around and showing an equivalent fraction) was presented only on the trials that elicited a correct response before or after delivery of the controlling prompt. Error responses were neither rewarded nor followed by instructive feedback.

Response definition. Five responses were possible. The students could (a) point to the correct choice (positive comparison) before the prompt--correct anticipations, (b) point to the correct choice (positive comparison) after the prompt--correct waits, (c) point to a negative comparison before the prompt--unprompted errors or incorrect anticipations, (d) point to a negative comparison after the prompt--prompted errors, or (e) give no response after the model. Training was considered to be at criterion when the students had 100% correct anticipations for six sessions--two sessions at continuous reinforcement, two with a FR2 schedule, and two with a VR4 schedule.

Reliability

Inter-observer agreement assessments occurred during probe and instructional conditions. An independent observer recorded students' responses and this record was compared to the data recorded by the teacher.

In addition, the observer recorded compliance of the teacher with the planned experimental procedures (i.e., procedural reliability) in the probe and instructional conditions (Billingsley, White, & Munson, 1980). The following instructor behaviors for the probe conditions were assessed for procedural reliability: ensuring student attention, presenting the correct stimulus, giving task directions, waiting the appropriate response interval, delivering non-committal feedback, and waiting the correct intertrial interval. The following behaviors for the instructional sessions were assessed for procedural reliability: ensuring student attention, presenting the correct stimulus, providing the task direction, waiting the appropriate response interval, delivering the prompt, providing the correct instructive feedback stimulus, and waiting the correct intertrial interval.

Results

Reliability

For student responses, the percentages of interobserver agreement were calculated using the point-by-point method (number of exact agreements divided by the number of exact agreements plus the number of disagreements and the quotient was multiplied by 100). For probe conditions, interobserver agreement was assessed on 15.5% of the sessions, and in all cases was 100%. In the instructional condition, interobserver agreement was based on 46.1%, and in all cases was 100%.

Procedural reliability was assessed on 15.5% of the probe sessions and 46.1% of the instructional sessions. Procedural reliability was calculated by dividing the number of actual teacher behaviors in each category by the number of planned behaviors and multiplying by 100 (Billingsley et al., 1980). During probes, the procedural reliability on all aspects of the procedure was at 100%. During instruction, the mean percentage of agreement on procedural fidelity was 100% on all aspects of the technique except for the following: giving praise/ignoring errors (95.8%; range 75-100%), and waiting the correct intertrial interval (98%; range 94-100%).

Reflexivity. Testing for equivalence consisted of tests for reflexivity, symmetry, and transitivity (Sidman & Tailby, 1982). Reflexive tests for all 24 fractions to be used in the three experiments were given prior to the onset of Experiment I. All five students had 100% correct performance on these tests.

Acquisition of target relation. The constant time delay procedure was effective in teaching all five students the target relations--pointing to the lowest form of a fraction when shown an equivalent fraction that was not in its lowest form. Performance on target behavior (A = B) in target check conditions (4 individually delivered trials) was 100% for all five students. In full probe conditions with all stimuli for all three experiments intermixed, following instruction on the sets of fractions in Experiment I, was at 100% for Ken and Barry, at 95.8% for Emma and Teddy, and at 91.6% for Drew. The number of sessions through criterion, the number of minutes of instruction, and the percent of errors during training are shown in Table 3. In this experiment, students had low error rates (0% to 9%) and they reached criterion in relatively few trials (32-48). Of these trials, 24 for each student were in sessions in which there were 100% correct anticipations.

Insert Table 3 about here

Acquisition of instructive feedback relations. Acquisition of the two behaviors for each target stimulus that were presented in instructive feedback (B=C and B=D) is shown in Figure 2. Four students showed an increase in correct responding from the pre-training probes to the post-training probes. One student, Drew, showed no change for either stimuli in either class. No student had 100% correct responding for these relationships.

Insert Figure 2 about here

Symmetry and transitivity. Performance during probes on the relationships that would show symmetry and transitivity also is shown in Figure 2. No student performed at 100% in all conditions. Emma and Drew each had 100% performance on one symmetry relationship to instructive feedback. All students showed some increase in performance on symmetry and transitivity trials but many were not above what could be considered chance levels.

Discussion

The purpose of this experiment was to determine whether a 4-member stimulus class would be formed by training A=B and alternating presentation of C and D in instructive feedback.

Due to the small number of probe trials per behavior (3 per behavior yielding 6 per relationship for the two stimulus classes), a criterion of nearly 100% correct responding was necessary to conclude that an equivalence class had emerged. The students showed a general increase in correct responding, but the control was neither strong nor consistent.

At least four factors, separately or in combination, may have influenced the subjects' failure to show equivalence. First, a limited number of trials and the limited number of exposures to the instructive feedback behaviors occurred. Fields et al. (1990) deduced that the degree of control exerted may be a derivative of the number of presentations that occurred. Second, the acquisition of the behaviors shown in instructive feedback was low. Other studies have shown that although instructive feedback can be effective, the acquisition is not always at 100% (Werts, Wolery, & Holcombe, 1991). Third, the subjects were naive. They may show greater acquisition when they have more experience with the experimental procedures. Fourth, it has been shown that testing may be an integral part of the learning process and our testing procedures were minimal, delivering only a few trials per behavior. Fields et al. (1990) stated that control was weaker at the beginning of the testing sessions and it became stronger as testing progressed. The subjects may not have had an opportunity to strengthen their responses during the testing phase of the procedure. To counteract some of these difficulties, Experiment II was initiated.

Experiment II

In this experiment, the constant time delay procedure with instructive feedback was used with the same subjects and similar stimuli (i.e., fractions). Thus, students had a history with the testing and instructional procedures. In addition, the number of stimuli presented through instructive feedback for each target behavior was reduced from two in Experiment I to one in Experiment II. Thus, each sample fraction, shown to each student in the daily instructional sessions, was linked to a single fraction shown in instructive feedback. This arrangement doubled the number of exposures to each instructive feedback stimulus but the number of exposures to each subject was still low (2 per instructive feedback stimulus per session). The specific question asked in Experiment II was: Would equivalence classes emerge from one training series using constant time delay with instructive feedback (i.e., conducting target training on only one relationship and introducing another relationship via instructive feedback)?

Methods

Subjects and Setting

The subjects and setting for Experiment II were the same as those used in Experiment I.

Materials

The materials differed only from those in Experiment I in the content of the fractions taught and the number of different instructive feedback stimuli used. The stimuli are shown in Table 2. Probe materials reflected the addition of 1 trial per behavior for Experiment II to give an equal number of pretraining trials as were used for Experiment I behaviors. Reinforcers remained the same.

Instructional Procedures.

Constant time delay was used to teach the fractions A1 = B1 and A2 = B2 in Set II (shown in Table 2). Following a correct response (before or after the controlling prompt), the C stimulus was shown. The number of trials per session on the target behaviors were identical to Experiment I. Experiment II is diagrammed in Figure 1.

In 20-trial session, each subject responded to 4 trials, (two with A1 = B1 and two with A2 = B2). Each instructive feedback stimuli, C1 and C2, was presented twice to each subject in each session. As in Experiment I, each subject had the opportunity to observe the responses of the other group members and the instructive feedback stimuli presented for the up to 16 additional trials. Attention to trials presented to the other students was neither required nor reinforced and no data on attending behavior were collected.

Results

Reliability

For student responses, the percentages of interobserver agreement were calculated using the point-by-point method (as in Experiment I). For probe conditions, interobserver agreement was assessed on 23.8% of the sessions, and in all cases was 100%. In the instructional condition, interobserver agreement was based on 35.7% of the sessions and in all cases was 100%.

Procedural reliability was assessed on 23% of the probe sessions and 35.7% of the instructional sessions. During probes, the procedural reliability on all aspects of the procedure was at 100% on all aspects of the procedure except waiting the correct intertrial interval (99.78; range 96-100%). During instruction, the mean percentage of agreement on procedural fidelity was 100% on all aspects of the technique except for giving praise/ignoring errors (98.8%; range 94-100%).

Acquisition of target relations. The five subjects were all trained to criterion level responding. The number of trials and time were not consistently lower than in Experiment I; these data are presented in Table 4. The error percentage was lower for Experiment II than for Experiment I. In target check probes (4 trials) all students had 100% correct responses. In full probe sessions following training, with intermixed stimuli from all experiments, Ken and Drew had 95.8% correct responses, Barry and Teddy and 91.6%, and Emma had 87.5%.

Acquisition of instructive feedback stimuli. The acquisition of the behaviors (B=C) shown in instructive feedback was low (see Figure 3). Only one student, Teddy, performed at a higher level on the post training probe than in the pretraining probes. Performance on instructive feedback for the other students was near the chance level.

Insert Figure 3 about here

Symmetry and Transitivity. The results of probing for symmetry and transitive relationships are shown in Figure 4. All five students had higher acquisition scores on the post training probes than on the pretraining probes for the symmetrical relationship to the trained behaviors (B=A). Teddy moved from 66% to 83% for the smallest gain of the five; Drew advanced from 17% in pretraining probes to 100% in post training probes. The transitive relationship (A=C) did not emerge more than might be expected from chance responding except for Emma's performance. She improved from 0% in pretraining to 50% in post training. The four other students either showed a decrease in correct responding or a modest (33%) increase. The symmetrical relationships to instructive feedback (C=B),and the transitivity (C=A) did not show acquisition that could be considered above chance levels.

Discussion

This experiment was initiated to determine whether a history with the technique and a decrease in the number of instructive feedback stimuli were sufficient to allow the emergence of a transitive relationship and the formation of a stimulus class. The results indicate that these modifications were not sufficient to allow the classes to form. However, training was again quite rapid. Thus, the students did not have a large number of exposures to the fractions shown in instructive feedback. Although the number of times these fractions were seen was doubled, the exposure was minimal (i.e., 18 to 28 presentations per stimulus). The redundancies in the stimuli also may have increased the difficulty of the task. Some of the digits in fractions A and C were the same, and the visual configurations were identical (two digits over two digits). Additionally, the students, although not required to do so, were verbally reciting the B (lowest form) stimuli as they pointed to it but were not employing a verbal response to the instructive feedback. Several investigators have questioned whether language mediation has an effect on the formation of stimulus classes (Constantine & Sidman, 1975; Devany, Hayes, & Nelson, 1986; Saunders, 1989). We did not require a language component but speculated whether the subjects' stating the lowest form had an effect. Thus, it was reasoned that if the instructive feedback stimuli were easier (i.e., was the lowest form of the fraction, had fewer digits, involved fewer words in naming) this may result in a greater probability of stimulus class formation. Also, if subjects had a history of previously stating similar fractions during previous experimental conditions, they may be more likely to state the instructive feedback stimuli and thereby assist in the formation of stimulus classes. Experiment III was conducted to test these possibilities.

Experiment III

Experiment III was conducted with the lowest form fraction as instructive feedback stimuli. The stimuli in position B, the one that the students might verbally respond to, was a fraction multiplied by a factor. The students were not required to respond verbally to this stimulus. The specific question asked in Experiment III was similar to that in Experiment II: Could students form equivalence classes in one training series using constant time delay with instructive feedback, conducting target training on only one relationship and introducing one other relationship via instructive feedback? The instructive feedback was the lower form of the fraction, and perhaps easier, than the A or B stimuli. Again, the training was conducted in a group situation in a classroom.

Methods

Subjects and Setting

The subjects and setting for Experiment III were the same used in Experiments I and II.

Materials

The materials differed from those in Experiment II in the content of the fractions taught. The students were trained to identify a fraction that was multiplied by a factor when shown an equal fraction multiplied by a different factor. The instructional feedback stimuli were the lowest forms of the fractions. The stimuli used are shown in Table 2. Reinforcers remained the same.

Instructional Procedures

Constant time delay was used to teach the fractions A1 = B1 and A2 = B2 in Set III (shown in Table 2). Following a correct response (before or after the controlling prompt), the C stimulus was shown on each qualifying trial. The experiment is diagrammed in Figure 1. The number and sequence of presentation of trials to the students remained the same as in Experiments I and II.

In a session of 20 trials, each subject responded to 4 trials, (two with A1 = B1 and two with A2 = B2) and were shown C1 and C2 (fractions in their lowest forms) in the instructive feedback. Each instructive feedback stimuli was presented twice to each subject in each session. As in Experiment I, each subject had the opportunity to observe the responses and the instructive feedback stimuli presented to the other subjects in the group. Attention to trials presented to the other students was neither required nor reinforced and no data on attending behavior were collected.

Results

Reliability

For student responses, the percentages of interobserver agreement were calculated using the point-by-point method. For probe conditions, interobserver agreement was assessed on 46.6% of the sessions, and in all cases was 100%. In the instructional condition, interobserver agreement was based on 72% of the sessions, and was 100% in all cases.

Procedural reliability was assessed on 46.6% of the probe sessions and 72% of the instructional sessions. During probes, the procedural reliability on all aspects of the procedure was at 100% on all aspects of the procedure except for delivering non-committal feedback (99.57; range 90-100%). During instruction, the mean percentage of agreement on procedural fidelity was 100% on all aspects of the technique except showing the correct stimuli (99.8%; range 96-100%).

Acquisition of target relations. The five subjects were again trained to criterion level responding within a minimal number of trials and time in training. The results are shown in Table 3. Emma had a error rate of 0%. The other subjects made some errors but less than 3.5% for any one student. In target checks following training, all students achieved 100% correct responding on the four trials. In full probes following training, Ken was given one day of probes and evidenced poor performance (25% on Tier III target behaviors) and he was returned to training for 6 sessions. Drew and Barry were given a full probe (three days). Drew performed poorly on the symmetry and transitivity relationships and was returned to training for 6 days and reprobed. Barry performed well on two days of probes but due to a change in his living quarters, he did not comply on the third day. He, too, was returned to training for 6 days. All three of these students performed at 100% for the 6 days and were given 2 days at continuous reinforcement, 2 days at FR2, and 2 days at VR4. Emma and Teddy did not receive extra training. In the probes following all training, four students scored 100% on target behaviors and Ken scored 95.8%.

Acquisition of instructive feedback relations. In probes on instructive feedback (B=C) following all training, Ken and Teddy performed at a 50% correct level with both students performing above their pre-training levels, and the other three students performed at 100% correct level. The results are shown in Figure 4.

Insert Figure 4 about here

Symmetry and Transitivity. Symmetry and transitivity relationships are shown in Figure 4. All students had higher acquisition levels on the symmetrical relationship to training (B=A) than in pretraining probes. Drew, Teddy, and Barry performed at 100%, Emma at 83%, and Ken at 66%. The symmetrical relationship to instructive feedback (C=B) showed similar patterns with Drew and Barry acquiring 100% of these behaviors. The transitive relationship and its symmetrical counterpart (A=C and C=A) were higher in all but one case (C=A) for Ken where it was equal to the pretraining level.

The acquisition levels seemed to indicate the formation of stimulus classes but performances were not perfect; therefore, repeated testing by another individual, the first author, were implemented. Performance stayed at 100% for Drew. Barry made one error on the first day of repeated probes but performed at the 100% correct level on subsequent days. The performance level rose to 100% for Teddy, Emma, and Ken. Ken made one error on the last day of probing in the symmetry of the trained relationship. He had scored at 100% level during the previous session.

Discussion

Moving the lowest form of the fraction (possibly easier) into the position of instructive feedback and the larger (possibly harder) fraction into the target position may have been the modifications that were needed to allow these five students form stimulus classes. The students continued to respond verbally to the B stimulus as well as point to the fraction on the sheet although they were not instructed to do so. They inconsistently verbally responded to the lowest form of the fraction seen in instructive feedback. Although no specific data was collected, it was observed that Emma did not verbalize the instructive feedback, Barry subvocalized the fraction in some of the later sessions. Ken, Teddy, and Drew verbalized the fractions infrequently. Further research is needed to determine whether the language mediator or the smaller fraction in instructive feedback had the greater effect or whether the interaction was critical.

General Discussion

The purpose of this series of experiments was to determine whether stimulus equivalence would emerge as a result of one conditional discrimination training using direct instruction augmented with instructive feedback. Several conclusions are suggested from the results.

First, students were able to form stimulus classes as a result of constant time delay training with the addition of instructive feedback. This effect was shown in the third experiment where the relationship established by instructive feedback was relatively strong. The rapid acquisition of the target behaviors resulted in a minimal number of exposures to the instructive feedback stimuli and relationships. Also, the post test performances on the target relationships were not perfect for most students in Experiment I and II. It was at 100% for three of the students in Experiment III and relatively high for the other two. The difficulty of the target task may have been a factor in Experiments I and II. By modifying the form of the instructive feedback stimuli and possibly by making the target task somewhat more difficult (although the training was still rapid) the students were able to form stimulus classes in a classroom rather than a laboratory setting. It is noteworthy that no special equipment, other than what is generally available in a classroom, was needed.

Efficiency of learning is a consideration in direct instruction studies. Many of the studies completed using stimulus equivalence have used many trials in a trial and error paradigm of conditional discrimination training and concern with the number of errors a subject could make were not a factor in the training. In these experiments, the time to criterion and number of trials was low for all students. The procedure took relatively little time from the student's school day. The error rate in these experiments was low (0 to 9%) with a mean of 2.2%. Lengthy conditional discrimination training may not be necessary to the emergence of stimulus classes given the appropriate selection of material or behaviors to acquire.

Language mediator as an adjunct to the pointing response may have been a large factor. This factor was not controlled. The fractions were in a form that the subjects were familiar with and that they could read in a standard acceptable form. Therefore, even if they had not vocalized the fractions in the instructive feedback, they could have applied a language mediator to the stimulus with subvocalization.

History or experience with the procedure may have affected the results. In other studies using constant time delay, training in the later tiers is generally more rapid than in the earlier tiers (Alig-Cybriwsky, Wolery, & Gast, 1990; Werts, Wolery, Holcombe-Ligon, Vassilaros, & Billings, 1992). During the third experiment, Emma spontaneously reported that she now knew what was expected and that she knew "the back of the cards, too." The procedures should be conducted again with naive students and with the simpler form of the stimulus in the instructive feedback position to determine whether stimulus classes could form without extensive history with the technique or whether it is necessary.

Stimulus equivalence may be a viable adjunct to direct instruction. Instructors should look for the effect and plan teaching sequences to take advantage of it in order to increase the efficiency of instruction. Informal analysis indicates that many fewer trials of instruction were needed in this near errorless instructional technique as compared to traditional conditional discrimination training. Clearly, further research is needed to merge the phenomenon of stimulus equivalence and direct classroom instruction.

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Table 1

Descriptions of Subjects

Name	Gender	Age	IQ[1]	Years of Special Education
Emma	F	12-11	111	2
Teddy	M	14-8	83	4
Barry	M	14-0	117	4
Ken	M	14-3	95	1
Drew	M	12-10	107	3

[1] WISC-R scores all obtained from school records. The tests were given by the school's psychologists.

Table 2

Stimuli used in Experiments I, II, and III

	Stimuli			
Experiment	A	B	C	D[1]
Experiment I	16/20 8/28	4/5 2/7	48/60 24/84	52/65 26/91
Experiment II	36/60 21/27	3/5 7/9	39/65 28/36	-- --
Experiment III	78/91 30/48	72/84 20/32	6/7 5/8	-- --

[1] "D" stimuli in Experiments II and III were dropped. See text for explanation.

Table 3

Efficiency data

Subject	Number of Trials	Time to Criterion	Percent of Errors
Experiment I			
Emma	44	47:37	0
Teddy	44	46:15	9
Barry	52	50:39	6
Ken	32	29:15	0
Drew	48	50:26	4
Experiment II			
Emma	36	35:44	0
Teddy	56	47:53	3.5
Barry	44	43:37	0
Ken	32	34:12	0
Drew	56	47:33	0
Experiment III			
Emma	30	32:57	0
Teddy	58	46:54	3.4
Barry[1]	74	55:13	2.7
Ken[1]	66	50:16	1.5
Drew[1]	73	49:15	1.3

1 These students were exposed to an additional 24 trials each due to poor probe performance following training. The additional trials were at 100% correct responding for all three students.

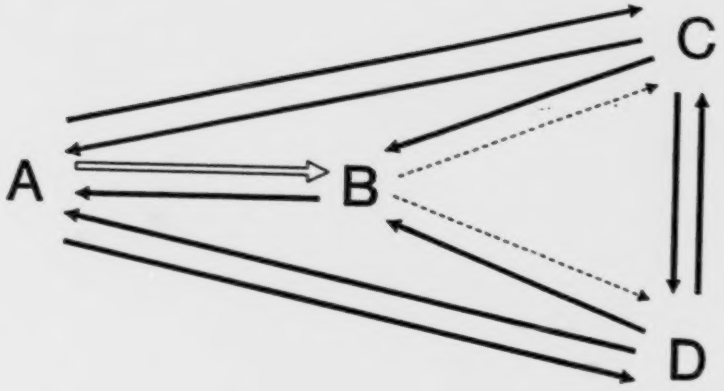
Figure Captions

Fig. 1. Diagrammatic representation of Experiment I (top) and Experiments II and III (bottom). The hollow line represents the trained relationship. The dashed line is the relationship established by instructive feedback. The solid lines were expected to be established through symmetry and transitivity.

Fig. 2. Acquisition of the relationships between the stimuli in Experiment I. The first graph shows the level of correct responding to the instructive feedback relationship by the five students. The other graphs show the level of correct responding to the symmetry and transitive relationships during pretraining and post-training probes.

Fig. 3. Acquisition of the relationships between the stimuli in Experiment II. The first graph shows the level of correct responding to the instructive feedback relationship by the five students. The other graphs show the level of correct responding to the symmetry and transitive relationships during pretraining and post-training probes.

Fig. 4. Acquisition of the relationships between the stimuli in Experiment III. The first graph shows the level of correct responding to the instructive feedback relationship by the five students. The other graphs show the level of correct responding to the symmetry and transitive relationships during pretraining and post-training probes. Repeated testing is shown as additional bars in each relationship.


C
A
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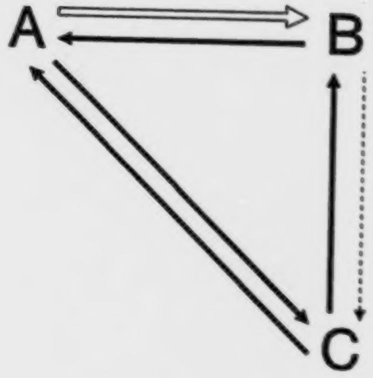
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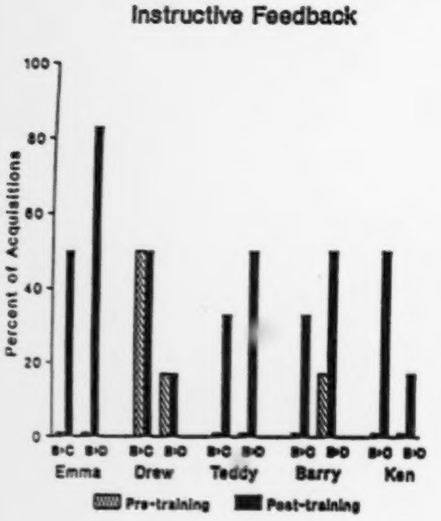

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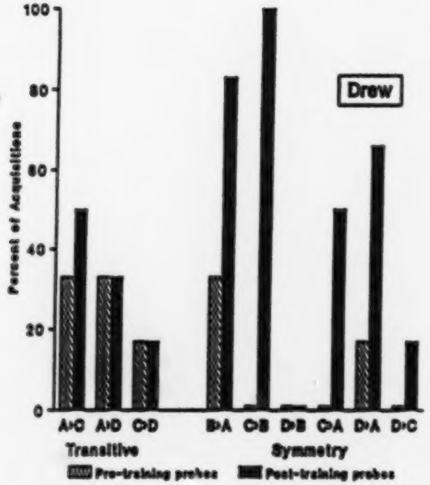

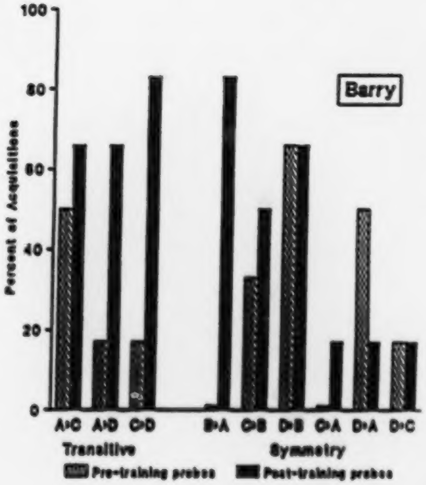

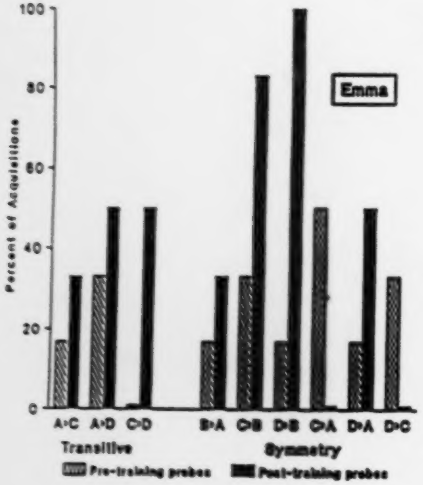

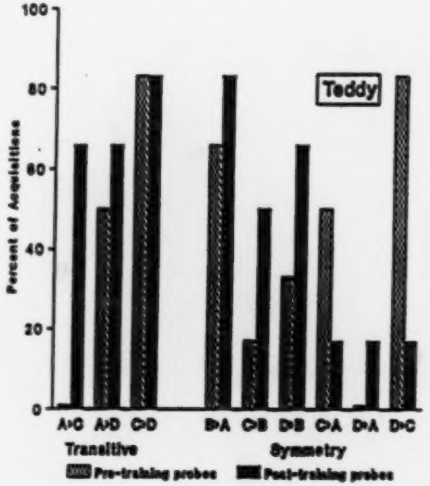

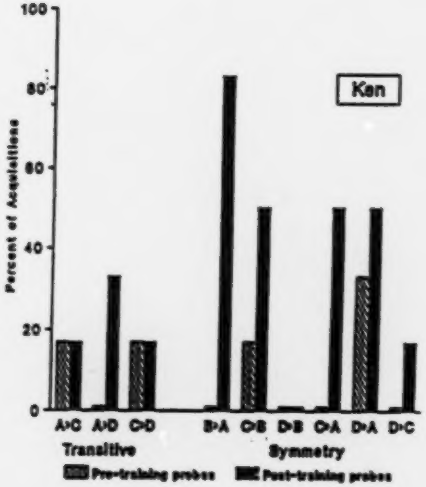

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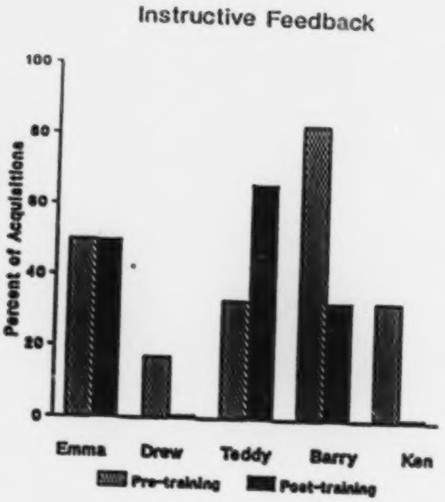

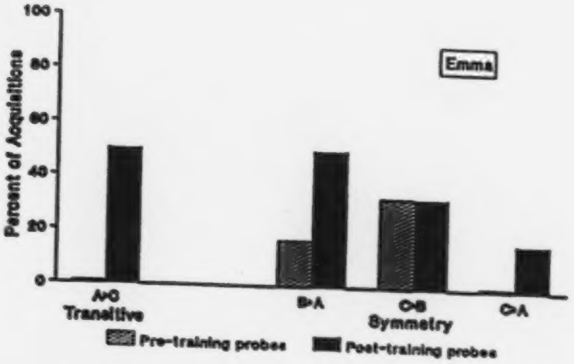

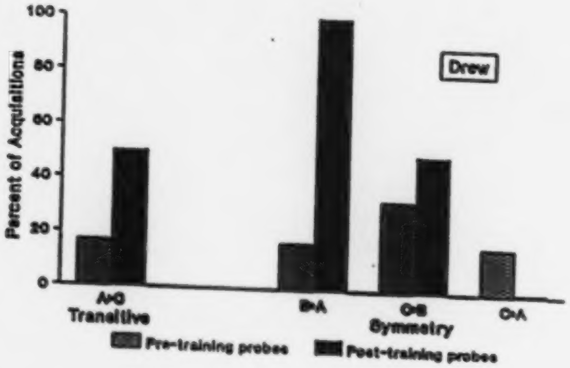

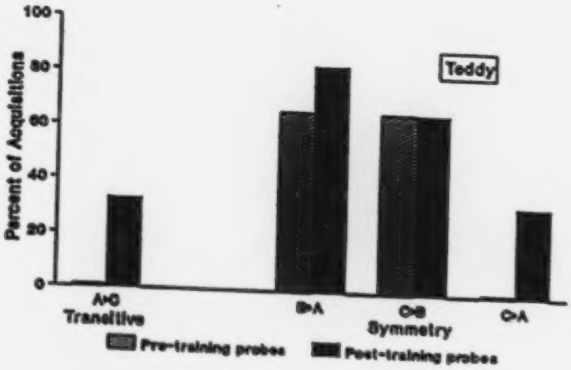

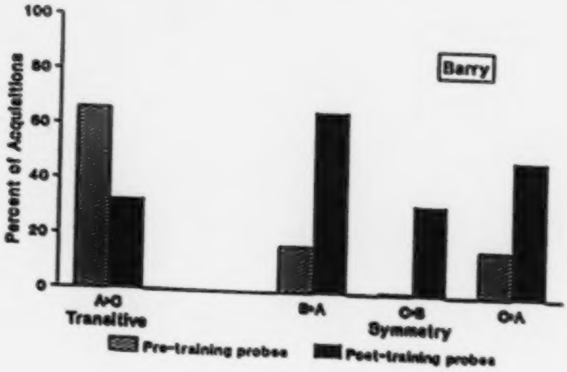

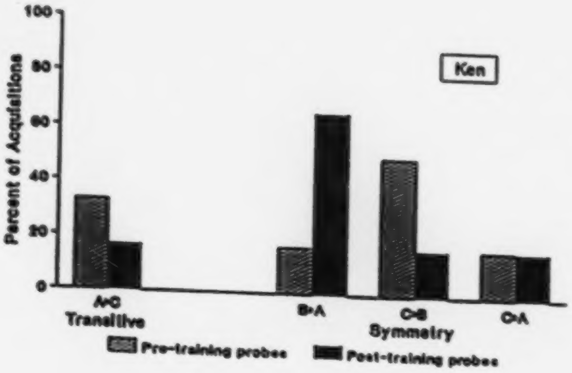

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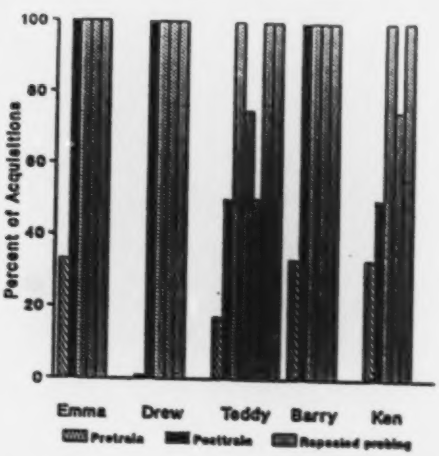

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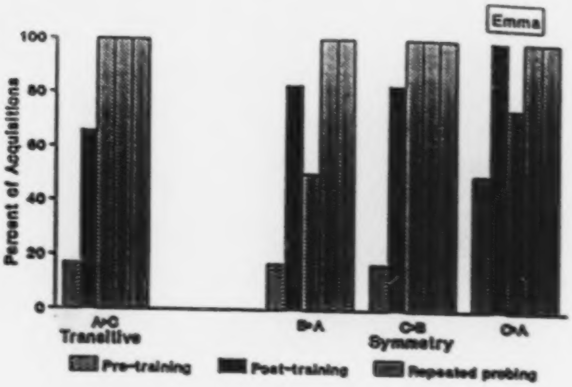

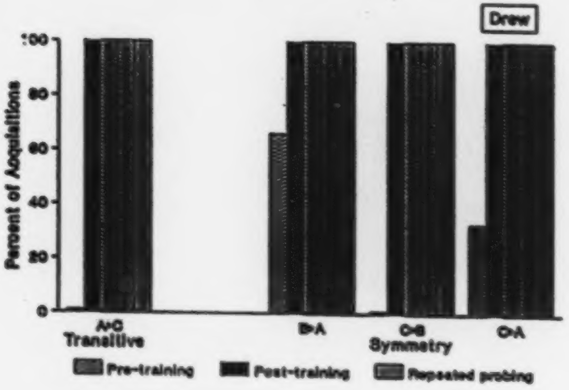

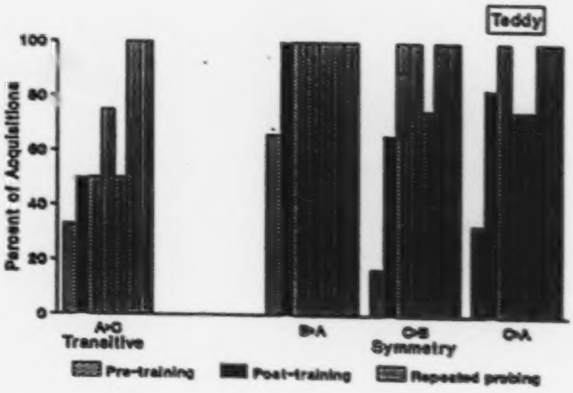

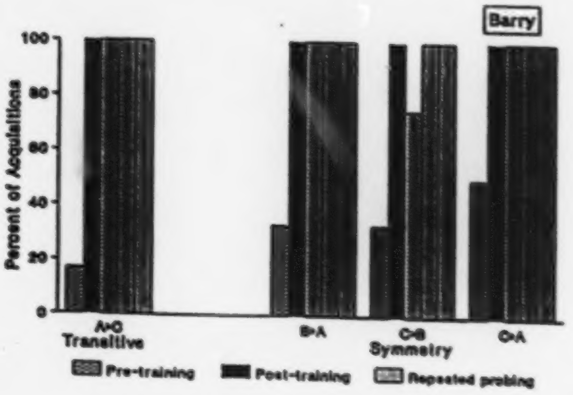

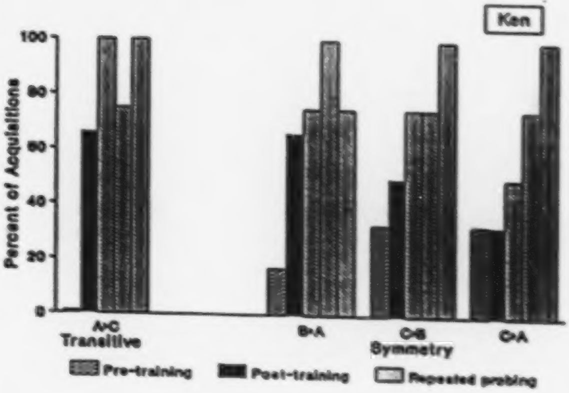

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Appendix H

Effects of Simultaneous Prompting and Instructive Feedback

Effects of Simultaneous Prompting and Instructive Feedback

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Abstract

This study evaluated the use of simultaneous prompting with instructive feedback regarding classification during praise statements on children's ability to receptively identify Rebus symbols and subsequently to classify those stimuli. Five, 3-year-old children with disabilities participated, and a multiple probe design across sets of behaviors was used to evaluate the simultaneous prompting strategy and instructive feedback. The results indicate that (a) the simultaneous prompting strategy was used reliably, (b) all children learned to identify all symbols that were taught, (c) children acquired second and third sets more rapidly than the first set of stimuli, (d) some of the children acquired the classification information presented through instructive feedback, and (e) generalization across stimulus size occurred for all the children (three) for whom it was assessed. Issues for further research with simultaneous prompting and instructive feedback are presented.

Effects of Simultaneous Prompting and Instructive Feedback

Young children with developmental disabilities frequently present instructional needs in communication and cognitive skills (Bailey & Wolery, 1992). Several response prompting procedures have been used to teach children such skills (Warren & Kaiser, 1988). These procedures include milieu strategies such as modeling, incidental teaching, the mand-model procedure, and naturalistic time delay (Halle, Alpert, & Anderson, 1984); and strategies associated with direct instruction such as constant and progressive time delay, system of least prompts, most-to-least prompting, and others (Wolery, Ault, & Doyle, 1992).

A relatively simple direct instruction procedure is the simultaneous prompting strategy. It involves presenting the target stimulus and immediately presenting a controlling prompt (i.e., one that ensures correct responding). The prompt is not faded during instruction, and learning is monitored in brief, separate daily probe sessions without prompts. For example, if a child needed to learn to read her name, the teacher would show her the written name and say, "What's this?" and immediately tell (i.e., model) the child the name. When the child imitated the model, the teacher would praise her. At some other time, the teacher would simply ask the child to read the name without telling her (i.e. probe trial). The procedure has been used to teach preschoolers with developmental delays to read words (Gibson & Schuster, in press). Also, it was compared to constant time delay and produced slightly more rapid learning of word reading by older students with moderate mental retardation (Schuster, Griffen, & Wolery, in press). A criticism of such research, however, is that the responses are not "high-order" skills such as concept development.

Promoting conceptual skills has interested educators for many years (Engelmann, 1969; Martorella, 1972). One such skill, classification, involves noting the defining characteristics of stimuli that are members of a given class, and noting the absence of those characteristics in stimuli that are not members. Although much is known about how to select stimuli (Albin & Horner, 1988; Hupp & Mervis, 1981), less is known about how to teach young children classification. A potentially useful strategy for promoting classification is teacher verbal behavior; that is, telling children that given stimuli are members of some class.

Information presented as verbal feedback during direct instruction has resulted in acquisition of new behaviors without being taught directly. For example, children learned to define (Stinson, Gast, Wolery, & Collins, 1991) and spell words (Gast, Doyle, Wolery, Ault, & Baklarz, 1991) when that information was presented verbally during feedback on word reading. Also, students learned to apply spelling rules (Wolery, Harrell, Gast, Ault, & Dunbar, 1991) and state factual information presented as verbal feedback (Wolery, Cybriwsky, Gast, & Boyle-Gast, 1991). These findings indicate that teachers' verbal feedback can contain new information, and students will learn large parts of that information without direct instruction. However, none of these studies addressed skills such as classification.

In this study, we evaluated the effects of a simultaneous prompting procedure in teaching young children with disabilities to identify Rebus symbols of food/liquids. Also, we assessed the effects of the teacher's verbal feedback on children's ability to classify the foods/liquids by when (i.e., for breakfast or for dinner) or how (i.e., eaten or drunk) they were consumed.

Methods

Students

Five children (36 months to 42 months of age) enrolled in a preschool for children with developmental delays participated in this study. Children had no prior experience with direct instructional procedures; 2 children attended the preschool 3 days a week and the remaining 3 children attended 5 days a week. Descriptive information of students is presented in Table 1.

Insert Table 1 about here

Prerequisite skills for participation were assessed through direct observation and testing by the investigator. These skills included: (a) ability to match to sample Rebus symbols, (b) visual and auditory acuity, (c) ability to follow task directions, (d) ability to imitate a gestural model, and (e) ability to sit and attend to a teacher and materials in the presence of one other child. Following the selection of children based on the assessment of these skills, screenings were conducted on the following skills to select target stimuli: (a) receptive identification of Rebus symbols from a three choice array in response to the task direction, "Point to hamburger.", and (b) receptive identification of the symbols in response to classification information (e.g., "Show me what we have for breakfast.") when a three choice array was provided.

Setting

The site coordinator and investigator conducted experimental sessions in the children's classroom. The class included nine children, one teacher, and two assistants. Experimental sessions occurred in a corner of the classroom enclosed by two walls and two shelves. Children were seated in small chairs with their backs to the classroom. A white magnetic board (0.6 m x .9 m) was placed against the wall facing the children. The instructor sat on the floor facing the children.

Materials

Receptive identification of Rebus symbols (Clark, 1983) was targeted for instruction based on children's current level of functioning and recommendations from the Speech/Language Pathologist. The children were either candidates for an augmentative communication board or were to use Rebus symbols in their speech therapy. Identification of Rebus symbols was an essential skill for both activities as viewed by the children's intervention teams. The symbols were .98 cm in height in black print glued to a white index card (1.95 cm x 3.12 cm). The word for the symbol was printed in lower case letters 0.2 cm in height approximately 0.39 cm above the symbol. A variety of juices and edibles served as reinforcers. Rebus symbols and classification information (i.e., whether the item was eaten or drunk or whether it was consumed at breakfast or lunch) by child and instructional condition are presented in Table 2.

Insert Table 2 about here

Procedures

General procedures. Children were assessed on prerequisite skills and screened to identify unknown Rebus stimuli. Six unknown stimuli were identified for each child and randomly assigned to pairs for instruction. Probe I was implemented, and then instruction began on the first symbol pair using the simultaneous prompting procedure. Four children were instructed in dyads and received one or two instructional sessions daily in a intrasequential group arrangement, and the fifth subject received individual instruction. Daily probes (two trials per stimulus) were conducted in a 1:1 instructional arrangement prior to each instructional session. Each child received training on two stimuli per instructional condition. Each instructional session consisted of 3 trials per stimuli and 6 trials per child. Stimulus presentation order was randomly assigned with children receiving a maximum of two consecutive trials on the same stimulus.

Target probe conditions. In probe conditions, receptive identification of all targeted Rebus symbols was assessed in 3 sessions across 2 days in a 1:1 arrangement. Each session consisted of 12 trials with 2 trials per stimulus. The trial sequence began with the instructor placing three symbols on the board in front of the child. The instructor gave a general attending cue (e.g., "Look.") while pointing to each symbol, followed by the task direction (e.g., "Point to (salad)."), and a 4-second response interval. Three responses were possible; corrects (correct pointing to stimulus within 4 seconds of the task direction), incorrects (pointing to any stimulus other than the target stimulus within 4 seconds of the task direction), and no responses (no response within 4 seconds of the task direction). Correct responses received verbal praise and an edible/juice, and errors and no response were ignored. Attending to task was reinforced on a variable ratio of every two trials (VR2). A 2- to 4-second intertrial interval was used.

Classification probe procedures. Receptive identification of a symbol in response to the task direction which included the classification information was measured during each target probe condition for one session. Bob, Doug, and Kim were assessed on their ability to classify stimuli by how it was consumed (eat and drink). Tim and Mary could classify the stimuli into eat and drink categories and were assessed on their ability to classify stimuli by when it was consumed (lunch and breakfast). The classification probe sessions consisted of at least two trials per target symbol for a minimum of 12 trials. The trial sequence was identical to target probe procedures with the exception of the task direction (e.g., "Point to what we have for breakfast."). Each stimulus array included the target symbol and two other symbols from the other classification group.

Daily probe procedures. Daily probe sessions occurred during the instructional conditions prior to each instructional session. Sessions were conducted in a 1:1 arrangement with 2 trials per stimulus for a total of 4 trials per session. The trial sequence was identical to the target probe procedures. The stimulus array included the two symbols being taught and a randomly selected foil.

Instructional procedures. The simultaneous prompting procedure was used to train receptive identification of two Rebus symbols in each instructional condition. The trial sequence for the simultaneous prompting procedure began with the teacher placing one stimulus at a time on the board until three stimuli were placed approximately 3.9 cm apart. The two target stimuli and one foil were presented for an entire session. Foils, which were food and drink items, were selected prior to instruction and randomly rotated through the sessions. The order of presentation was randomly assigned. The teacher ensured the child's attending by saying "(Child's name), look." and touching each stimulus. After the child looked, the teacher presented the task direction (e.g., "Point to (salad).") and simultaneously presented the controlling prompt (i.e., pointed to the correct stimulus). Three types of responses were possible; correct responses (pointing to the correct symbol within 4 seconds of the model), incorrect responses (pointing to a symbol other than the correct symbol within 4 seconds of the model), and no response (no response within 4 seconds of the model). Correct responses were followed with descriptive verbal praise which included a statement of the classification information for that stimulus (e.g., "That's right. We eat salad for lunch."). Edibles were given on a VR2 schedule for correct responses. Errors and no responses were ignored. An intertrial interval of 2- to 4-seconds was used. Criterion was set at 100% correct responses for two sessions on a CRF schedule and 100% correct responses for two sessions on a VR2 schedule during daily probe sessions.

Generalization. Generalization was assessed across size of stimuli. Rebus symbols used in training were 0.98 cm in height and mounted on index cards (1.9 cm x 3.1 cm). Rebus symbols used in generalization probes were .59 cm in height and mounted on index cards (1.6 cm x 2.3 cm). Generalization probes were conducted identically to target probes.

Experimental Design

A multiple probe design (Tawney & Gast, 1984) across three sets of behaviors replicated across five children was used to evaluate the effectiveness of the simultaneous prompting procedure. The experimental conditions occurred in the following sequence: (a) individual probe sessions on all six target behaviors and on classification; (b) simultaneous prompting implemented on the first pair of behaviors until criterion level responding was established in daily probe sessions; (c) individual probes on all six behaviors and on classification; and (d) repeat this sequence with the next pair of stimuli.

Reliability

Inter-observer agreement and procedural reliability data were collected by a trained observer. A point-by-point method (number of agreements divided by the number of agreements plus the number of disagreements multiplied by 100) was used to calculate inter-observer agreement percentages. Procedural reliability data were calculated by dividing the number of actual teacher behaviors by the number of planned teacher behaviors and multiplying by 100 (Billingsley, White, & Munson, 1980). Measured teacher behaviors were: sequencing stimulus presentation, presenting the attending cue, ensuring a look response, presenting task direction, delivering controlling prompt, waiting 4-second response interval, delivering consequent event, stating classification information in the feedback event, and waiting the intertrial interval.

Results

Reliability

Reliability data were collected in 33% of the full probe sessions for Bob, Tim, and Mary; and 40% of full probe sessions for Doug and Kim; reliability data also were collected in 26% of the daily probe and instructional sessions for Bob and Kim; 27% for Tim; 25% for Mary; and 21% for Doug. The percent of agreement on student responding in each session for each student was 100. The mean percentage of agreement on procedural fidelity was 100 with the following exceptions: (a) sequence of stimulus presentation was 97 (83-100) for Kim and Mary and 99 (83-100) for Bob, (b) ensuring an attentional cue was 99 (83-100) for Bob; and (c) including the classification information was 99 (83-100) for Tim.

Effectiveness

The simultaneous prompting procedure was effective in teaching five children to receptively identify Rebus symbols. Three children (Bob, Tim, and Mary) learned to identify six Rebus symbols. Doug learned four Rebus symbols; due to the end of the school year, he did not receive instruction on the final two symbols. Kim learned the first pair of symbols; instruction ended because her family moved out of the state. The percentage of correct responses for each student by probe condition are presented in Table 3.

Insert Table 3 about here

The number of instructional sessions and the number of minutes involved in daily probes and instruction through criterion are presented for each student and symbol pair in Table 4. The number of sessions required for each subject to reach criterion on each symbol pair varied across students (e.g., 4 for Mary on symbol pair II, and 23 for Kim on symbol pair I). Similarly, the number of sessions within subjects varied; for example, Bob required 8 sessions for symbol pair I, 6 for pair II, and 5 for pair III. The children who learned multiple sets (Bob, Tim, Mary, and Doug) required the largest number of sessions on the first pair. The number of minutes of instruction also was greatest for the first pair. Mary acquired Pairs II and III in the minimum number of sessions needed to reach criterion (i.e., 4, two sessions with CRF reinforcement and two sessions with VR2 reinforcement). Bob acquired Pair III and Tim acquired Pairs II and III in the minimum number of sessions plus one (i.e., 5 sessions). The average duration of daily probes was less than 2 minutes; for Bob the mean duration was 1 minute 20 seconds, for Tim it was 1 minute 30 seconds, for Mary it was 1 minutes 14 seconds, for Doug it was 1 minute 47 seconds, and for Kim it was 1 minute 55 seconds.

Insert Table 4 about here

Acquisition of Classification

The acquisition of the classification information provided as instructive feedback during simultaneous prompting was assessed during full probe conditions, and the data are presented in Table 5. Bob and Mary correctly classified all target symbols during the final probe of classification. Doug correctly classified all symbols during all trial presentations with the exception of "water". He did not respond correctly to this stimulus during any of the classification probes. Tim correctly identified only "bacon" and "sandwich" during the final probe session across all trial presentations. Kim correctly classified "water" and "cereal" across all trial presentation of her final probe condition.

Insert Table 5 about here

Generalization

Generalization across stimulus size was measured with Bob, Tim, and Mary. These measures were not conducted with Kim due to an unexpected move or Doug due to the end of the school year. These data were collected as pretest/posttest measures. During the pretest, correct responding was at or slightly below chance levels. During the posttest, correct responding was 100% for all symbols for the three students. Thus, for the three children for whom generalization data were collected, all generalized receptive identification across stimulus size.

Discussion

This study assessed the effectiveness of the simultaneous prompting procedure in teaching young children with disabilities to receptively identify Rebus symbols, and assessed whether they could identify foods and liquids according to classification information provided as feedback during instruction. Based on the results, several findings are apparent. First, the simultaneous prompting procedure was implemented with high procedural fidelity. This was expected because of the procedure's simplicity. With the simultaneous prompting procedure, the teacher secures children's attention, and presents the target stimulus followed immediately by, or presented simultaneously with, a prompt. The teacher does not delay prompts as with the constant and progressive time delay, provide a hierarchy of prompts as with the system of least prompts, or make judgments about fading prompts as with graduated guidance (Wolery et al., 1992). This simplicity may allow the procedure to be used with little teacher training. Thus, it may have broad application in mainstreamed sites where teachers typically have less training in special education instructional technology. Clearly, research with the procedure in such contexts is warranted.

Second, the simultaneous prompting strategy was effective in teaching all students to identify all Rebus symbols that were taught. This effectiveness replicates earlier research (Gibson & Schuster, in press; Schuster et al., in press), and extends it to younger children with more substantial disabilities.

Third, subsequent pairs of symbols were acquired more rapidly than the first pair. This finding replicates previous research where continued instruction across similar stimuli results in learning to learn (Godby, Gast, & Wolery, 1987). Substantial increases in learning rates were noted for some subjects. For example, Doug acquired his second pair of symbols in one third the number of sessions required for the first pair; Mary acquired the second and third pairs in the same number of sessions (i.e., 8) she required for the first pair. Thus, repeated use of the procedure, especially with children who have little experience with direct instruction, may produce more rapid learning of subsequent skills.

Fourth, the time involved in the daily probe sessions averaged less than 2 minutes per day per subject. Because the controlling prompt is provided on all trials during instructional sessions, children do not have the opportunity to respond without prompting. Thus, the daily probes are needed with this procedure to assess whether stimulus control is transferred from the prompt to the target stimulus. In this study, the daily probing did not require a substantial amount of time; however, subsequent research should evaluate whether less frequent probing (e.g., every other day) would be adequate to monitor children's learning. Also, subsequent research should evaluate the instructive role, if any, such probes play in the simultaneous prompting procedure.

Fifth, some students acquired classification information that was presented as feedback. In earlier research students acquired extra information that was presented in the feedback events with constant time delay (Gast et al., 1990) and progressive time delay (Stinson et al., 1991). It should be noted that children were not required to respond to this information (except in probe conditions assessing its acquisition). The classification information was simply included in the teacher's praise. Thus, "extra" information can be acquired with minimal changes in teacher behavior and without extra instructional sessions. Previous research has shown that the addition of extra information does not substantially increase the length of instructional sessions (Holcombe, Wolery, Werts, & Hrenkevich, 1991). Future research should address issues related to how to present extra information (e.g., is it necessary on each trial?) and whether other higher-order skills can be acquired readily.

Sixth, generalization across stimulus size occurred for all children for whom it was assessed. Prior to instruction, children did not identify the symbols correctly nor did they match the smaller size stimuli. On posttests they correctly responded to smaller stimuli and matched novel stimuli of the smaller size. This suggests that they learned to attend to the relevant characteristics of small 2-dimensional stimuli.

These findings taken with those from previous research on simultaneous prompting indicate that the procedure has been effective in teaching preschoolers with disabilities and is relatively easy to use (e.g., Gibson & Schuster, in press). Thus, it may have broad application in mainstreamed early education contexts. Specifically, a primary concern of parents related to preschool mainstreaming deals with instructional effectiveness (Bailey & Winton, 1987); that is, they report concern that instruction in mainstreamed classrooms may not result in adequate learning. Similarly, based on a national survey, teachers in mainstreamed settings cite their lack of training in how to teach children with disabilities as the major barrier to preschool mainstreaming (Wolery, Brookfield, Venn, & Fleming, 1990). This procedure, along with others, may address these two concerns. It can be an effective instructional tool for teachers in mainstreamed sites, and its simplicity suggests a need for relatively little additional training. Further, other research has documented that it produces learning that is as efficient as constant time delay (Schuster et al., in press), and that constant time delay is as or more efficient as other known alternatives (e.g., the system of least prompts, most-to-least prompting, progressive time delay, etc.) (Wolery et al., 1992). However, simultaneous prompting requires fewer teacher decisions and behaviors than these other procedures; thus, it may be easier for teachers to learn. In addition, as demonstrated in this study, the inclusion of instructive feedback (i.e., the classification information) can be used to teach additional skills while teaching target behaviors. This means teachers can likely address multiple instructional objectives in less teaching time. Despite these positive features, a major limitation of this study is that it does not address whether the daily probes are necessary for learning. It is possible that they contribute to children's ability to learn from the procedure. However, this issue awaits further experimentation.

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Table 1

Student Demographics

Student	CA[a]	Days/ Week	Disability	Developmental Ages[b]				
				Social	Adaptive/ Daily Living	Motor	Communication	Cognitive
Bob	36	5	Developmental Delay/Language Delay	20	24	28	18	24
Tim	37	5	Down Syndrome	21	23	24	18	26
Kim	36	3	Down Syndrome	28	24	24	19	30
Doug	42	5	Down Syndrome/ Congenital Heart Disease	16	13	19	14	--
Mary	38	3	Down Syndrome	30	19	21	30	--

---

[a] CA = Chronological Age.

[b] Developmental age scores for Bob, Tim, and Kim were derived from the *Batelle Developmental Inventory* (Newborg, Stock, Wnek, Guidubaldi, & Svinicki, 1984); and scores for Doug and Mary were derived from the *Vineland Adaptive Behavior Scales* (Sparrow, Balla, & Cicchetti, 1984).

Table 2

Rebus Symbols and Classifications Information by Child and Instructional Conditions[a]

Child	Instructional Condition 1	Instructional Condition 2	Instructional Condition 3
Bob	juice - D	water - D	milk - D
	cereal - E	bacon - E	toast - E
Tim	bacon - B	juice - B	toast - B
	water - L	sandwich - L	pop - L
Mary	bacon - B	juice - B	toast - B
	water - L	salad - L	pop - L
Doug	water - D	juice - D	pop - D
	cereal - E	raisins - E	pizza - E
Kim	water - D	juice - D	pop - D
	cereal - E	raisins - E	pizza - E

[a] D = drink
E = eat
B = breakfast
L = lunch

Table 3

Mean Percentage of Correct Responses by Students and Probe Conditions

Student	Probe Conditions[a]			
Behaviors	I	II	III	IV
Bob				
Juice/Cereal	16	100	100	91
Bacon/Water	33	16	100	100
Toast/Milk	25	16	0	100
Tim				
Water/Bacon	16	100	100	100
Juice/Sandwich	33	0	100	100
Pop/Toast	16	0	16	100
Mary				
Bacon/Water	25	100	100	100
Salad/Juice	16	0	100	100
Toast/Pop	33	8	8	100
Doug				
Water/Cereal	25	100	83	---
Juice/Raisins	16	33	83	---
Pizza/Pop	16	41	100	---
Kim				
Cereal/Water	16	91	---	---
Juice/Raisins	25	33	---	---
Pop/Pizza	33	91	---	---

[a] Lines through data indicate when instruction occurred.

Table 4

Number of Sessions, Daily Probe Time, and Minutes of Direct Instruction Through Criterion by Students and Behaviors

Student Behaviors	Number of Sessions[a]	Daily Probe Time Through Criterion	Direct Instruction Time Through Criterion[b]
Bob			
Juice/Cereal	8	10:55	20:30
Bacon/Water	6	8:01	10:02
Toast/Milk	5	6:34	14:12
Tim			
Water/Bacon	8	11:43	42:18
Juice/Sandwich	5	7:11	19:34
Pop/Toast	5	8:04	27:20
Mary			
Bacon/Water	8	9:00	39:04
Salad/Juice	4	4:08	20:10
Toast/Pop	4	5:34	27:40
Doug			
Water/Cereal	21	33:58	1:36:44
Juice/Raisins	7	15:49	24:25
Kim			
Cereal/Water	23	43:57	1:50:54

[a] Minimum number of sessions to demonstrate criterion level responding was 4: two sessions at CRF and two sessions at VR2.

[b] Tim and Doug were taught in a dyad and Mary and Kim were taught in a dyad; instructional time was calculated by adding total session times until subjects met criterion.

Table 5

Mean Percentage of Correct Responses to Classification Categories by Students and Probe Conditions

Student	Probe Conditions[a]			
Behaviors	I	II	III	IV
Bob				
Juice/Cereal	50	100	100	100
Bacon/Water	0	25	83	100
Toast/Milk	25	0	50	100
Tim				
Water/Bacon	0	75	83	66
Juice/Sandwich	25	0	66	66
Pop/Toast	25	0	66	33
Mary				
Bacon/Water	25	100	100	100
Salad/Juice	50	0	83	100
Toast/Pop	0	25	16	100
Doug				
Water/Cereal	25	75	50	---
Juice/Raisins	25	25	33	---
Pizza/Pop	25	0	33	---
Kim				
Cereal/Water	25	100	---	---
Juice/Raisins	50	0	---	---
Pop/Pizza	0	25	---	---

[a] Lines through data indicate when instruction occurred.

Appendix I

Effects of Presenting Incidental Information in the Consequent Events on Future Learning

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Effects of Presenting Incidental Information in Consequent Events on Future Learning

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The effects of presenting future target stimuli in the consequent event following correct responses to current target stimuli were examined in two experiments teaching eight students with moderate handicaps to name photographs. In Experiment I, progressive time delay was used to teach two sets of photographs. During instruction, correct responses to one set of stimuli resulted in praise and presentation of the printed word for the person in the photograph (future condition). In the second set, a correct response was followed by praise alone (non-future condition). After establishing criterion level performance on both sets of photographs, students were taught to read the printed word from each of the two sets. Experiment II was a systematic replication of Experiment I. Four students from a different classroom also were taught to name two sets of photographs. An adapted alternating treatments design was used in each experiment. The results indicated that (a) all students learned to name the photographs; (b) presentation of future target stimuli (words) in consequent events resulted in seven of the eight students learning to read some of the words; and (c) the total number of sessions, trials, errors, and percentage of errors

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needed to teach students four photographs and four words were lower for the future condition than the non-future condition. The results are discussed in terms of increasing the efficiency of instruction.

KEY WORDS: progressive time delay; words; photographs; alternating treatments design.

In the past 20 years, considerable research has focused on identifying effective instructional strategies for teaching students with moderate to severe mental retardation a variety of useful skills (Ault, Wolery, Doyle, & Gast, 1989; Billingsley & Romer, 1983; Doyle, Wolery, Ault, & Gast, 1988; Wolery, Ault, & Doyle, in press). Effectiveness has been defined in this research as a demonstration that students learned what was taught. A strategy is described as effective if students acquire the skills that were taught when it is used. Recently, emphasis also has been placed on assessing the efficiency of instruction (Ault et al., 1989). Efficiency is defined as effective instruction that results in learning with less effort or energy when compared to some other form of instruction. To be called efficient, a strategy must meet two criteria. First, it must be effective (i.e., result in learning), and second, it must result in "better" learning than some other instructional strategy.

Five conceptualizations of instructional efficiency have been proposed (Wolery & Gast, 1990). First and most commonly described, efficiency is conceptualized as the rapidity of learning. One strategy is said to be more efficient than another if it results in an equal amount of learning in fewer sessions, trials, and/or minutes of direct instructional time to criterion. Second, efficiency can be viewed as providing more generalized performance. For example, two strategies could result in equally rapid learning, but the strategy that resulted in greater generalization across persons, settings, and materials would be labeled as more efficient. Third, efficiency has been conceptualized as producing broader learning. Again, two strategies could result in equally rapid learning and equal generalization of the acquired skills, but one strategy may result in learning behaviors that were not directly targeted for instruction. These nontargeted behaviors could, for example, be acquired through observational or incidental learning. Fourth, efficiency has been conceptualized as the emergence of relationships that are not directly taught. This conceptualization has been investigated under the rubric of the acquired equivalence or transfer mediational paradigms. One instructional strategy would be considered more efficient if it resulted in the acquisition of relationships that were not directly taught and the second strategy did not. Fifth, efficiency has been conceptualized as instruction that positively influences later learning. For example, two instructional strategies could be used and result in equally rapid learning, but one strategy may allow students to learn future target behaviors more rapidly than the other.

The current investigations focused on the fifth conceptualization of efficiency (i.e., effects on future learning). The purpose of the studies was to determine if "current" instruction could be systematically manipulated to cause students to learn "future" behaviors more efficiently. The specific manipulation studied was the presentation of additional (future) stimuli in the consequent events for correct responses. Past research has indicated that presenting additional information in the feedback statements results in incidental learning of some of that information (Doyle, Gast, Wolery, Ault, & Farmer 1990; Gast, Wolery, Morris, Doyle, & Meyer, 1990; Gast, Doyle, Wolery, Ault, & Baklarz, in press; Wolery, Cybriwsky, Gast, & Boyle-Gast, in press). For example, Gast et al. (in press) taught students to read sight words. In the descriptive praise statements for correct responses, the teacher told students the definition of the word they had just read. All students learned to state some of the definitions. The current investigations sought to determine whether presentation of "future" target stimuli in the consequent events following correct responses would result in more efficient learning of those stimuli when they became the focus of instruction. Specifically, the research question addressed in this study was: If students are taught to name photographs and are shown a written word for the photo following each correct response, will they learn to name the photographs and read the written words more rapidly?

EXPERIMENT I

Method

Participants and Setting

Participants in Experiment I included four students (2 females and 2 males), ranging in age from 9 years 5 months to 13 years 7 months, who were enrolled in a public school classroom for students with moderate disabilities. In addition to normal visual and auditory functioning with corrective appliances when needed, each participant met the following entry criteria: (a) previous history with systematic response prompting procedures (student could wait up to 6 sec for a prompt and orally imitate an expressive model by the teacher); (b) ability to identify photographs (student could name a minimum of 3 photographs of occupations); and (c) minimal sight word reading ability (student could identify at least 3 survival words). Additional decriptions of participants are presented in Table 1.

Experimental sessions were conducted by the teacher in the students' self-contained portable classroom adjacent to a public elementary school. The classroom consisted of six rooms, including a kitchen area, a room for occupational and physical therapy, and several (2.0 m × 3.0 m) rooms for small group and individual instruction. The experimental sessions occurred in a room with a rectangular table, chairs, and classroom instructional materials on shelves. The teacher sat directly opposite the student. Students not involved in the investigation participated in their normal classroom activities with another teacher.

Materials

A total of eight colored photographs *Photo Cue Cards* (Kerr, 1985) were selected as the current target stimuli. Words selected as future target stimuli were printed in black lower case letters on white (10 cm × 15 cm) index cards. The reinforcers included small candy bars (e.g., Snickers, Milky Ways M. & M's) and a variety of inexpensive toys. The target stimuli are presented in Table 2.

Procedures

General Procedures. Conditions were implemented in the following sequence: Probes (photographs and words), photograph instruction (future and non-future), reinstate probe condition, word instruction, and a final probe condition. Progressive time delay in individual instructional sessions was used to teach eight photographs depicting occupations found in the community. The photographs were divided into two sets of four stimuli each; correct responses in one set resulted in praise and presentation of the printed word for the occupation depicted in the photograph (future condition) and correct responses in the second set resulted in praise alone (non-future condition). Photographs were assigned to the two conditions to minimize the differences between the sets. Each set contained an equal number of photographs across similar numbers of syllables, beginning and ending letters, and the students' ability to orally name the function of the occupation (e.g., when shown a picture of a veterinarian, students could say "He works with animals,"). Each student was taught the same two sets of photographs. Two students were taught Photograph Set A with the future condition (i.e., praise plus presentation of the printed word) and Photograph Set B with the non-future condition (i.e., praise alone). The other two students were taught Photograph Set A with the non-future condition (praise only) and Photograph Set B with

Table 1. Description of Participants in Experiments I and II

Student C.A.	Test score	Diagnosis	Functioning level
		Experiment I	
Casey 13-7	WISC-R; IQ 45	Autism; Mental Retardat.	Reading achievement, spelling, and math scores were 46; reads grocery words; time to 5 min; I.d. days and months; relates personal info.
Ada 10-7	WISC-R; IQ 45	Microcephaly; Mental Retardat.	Reading achievement, spelling, and math scores were 46; time to 5 min; age-appropriate social skills with nonhandicapped peers; calculator to purchase groceries; counts change.
Deanna 9-5	WISC-R; IQ 45	Mental Retardat.	Identifies days of week; tells personal info; near age-appropriate gross motor and self-care skills; tell time to 5 min.
Tom 11-8	WISC-R; IQ 51	Mental Retardat.	Reading achievement 49; for spelling and math, 46; reads 1st grade; writes personal info; counts change; washes dishes, mops floor.
		Experiment II	
Chris 9-9	WISC-R; IQ 40	Mental Retardat.	Reads 10 survival signs and days of week; Identifies upper and lower case letters; writes full name and copies address; counts 1-20 items; recognizes # 1-20.
Tommy 11-1	Stanford-Binet; IQ 42	Mental Retardat.	Reads survival signs; identifies upper and lower case letters; writes full name; tells time to the hour; counts 12 items; uses calculator (enters prices and subtracts totals).
Carrie 8-5	Stanford-Binet; M.A. 4-10	Mental Retardat.	Reads 12 survival words; recognizes letters; counts 1-20 items; writes name; copies address; uses calculator (enters prices, subtracts totals).
Jarrod 6-10	Stanford-Binet; IQ 51	Mental Retardat.	Recognizes upper and lower case letters; I.d. # 1-10; counts 5 items; copies full name; uses calculator (enters prices, subtracts totals).

the future condition (praise plus word). The order of introduction of the two instructional conditions also was counterbalanced across students. Two sessions were conducted daily: one future and one non-future session.

Following acquisition of photograph naming, progressive time delay was used to teach students to read the words for each occupation depicted in the photographs. All words were divided into two sets: one set of words to which students had been exposed in the photograph naming condition and one set of words they had not seen in the photograph naming conditions.

Probe Procedures. Prior to instruction, students were assessed on naming the photographs and reading the words. Each probe condition consisted of six sessions or until the data were stable; i.e., three sessions for the photographs and three for the words. The probe sessions were randomly presented across days. Each probe session consisted of 24 trials (three trials on each of the current or future target stimuli). Prior to beginning a probe session, each student selected a prize, which was delivered noncontingent of performance at the end of a session. A probe trial consisted of the teacher holding the target stimulus in front of the student, presenting the attending cue ("*Name,* look."), ensuring an attending response, delivering the task direction ("What is this?"), and providing a 4-sec response interval. All student responses to the task direction were followed by the teacher waiting a 3-5-sec intertrial interval and presenting the next trial. Students were reinforced every six trials for attending to the target stimulus.

Photograph Instruction. A progressive time delay procedure was used to teach each student two sets of four occupation photographs. Each instructional session consisted of 24 trials (six trials on each of four stimuli in a set). Before each session, students were asked to select a prize to be delivered noncontingent of performance at the end of an instructional session. The first session for both sets of photographs was at the 0-sec delay. A 0-sec trial began with the teacher presenting a photograph, delivering an attending cue ("Name, look."), ensuring an attending response, presenting the task direction ("What is this?"), and immediately delivering the controlling prompt (a vocal model of the correct response by the teacher). In each subsequent session, the delay interval was increased by 1-sec increments (i.e., session 2, 1-sec; session 3, 2-sec; session 4, 3-sec interval) to a maximum of 6 seconds. The delay interval remained at 6 sec until the student reached criterion level responding. Instruction continued in each of the treatment conditions until a student reached criterion level responding; that is, two sessions of 100% correct unprompted responding, one session using a continuous schedule of reinforcement (CRF) and one session with approximately six reinforcers delivered for correct responding (VR4).

Table 2. Target Stimuli Across Students and Conditions for Experiments I and II

		Experiment		
Condition stimuli	Student name	Current stimuli	Photograph set	Future target stimuli presented
		Experiment I		
Future	Casey	secretary	A	YES word
Photographs	Ada	butcher		YES word
		veterinarian		YES word
		cashier		YES word
Non-Future	Casey	mechanic	B	NO
Photographs	Ada	barber		NO
		electrician		NO
		gardener		NO
Future	Deanna	mechanic	B	YES word
Photographs	Tom	barber		YES word
		electrician		YES word
		gardener		YES word
Non-Future	Deanna	secretary	A	NO
Photographs	Tom	butcher		NO
		veterinarian		NO
		cashier		NO
		Experiment II		
Future	Chris	Little Caesars	A	YES word
Photographs	Tommy	Ritzy's		YES word
		Wendy's		YES word
Non-Future	Chris	White Castle	B	NO
Photographs	Tommy	Jerry's		NO
		Shoney's		NO
Future	Carrie	White Castle	B	YES word
Photographs	Jarrod	Jerry's		YES word
		Shoney's		YES word
Non-Future	Carrie	Little Caesars	A	NO
Photographs	Jarrod	Ritzy's		NO
		Wendy's		NO

Future Photograph Condition. Two types of correct responses could occur during an instructional session. If the student responded correctly before the prompt was delivered (unprompted correct) the teacher delivered praise (e.g., "Good, that is right.") and showed the student the printed word for the occupation depicted in the target photograph. The teacher did not say the name of the occupation when presenting the printed stimulus. If the student waited for the teacher to deliver the controlling prompt and responded correctly after the prompt (prompted correct), the teacher also delivered praise and the printed word. If a student made an error before the prompt was delivered (unprompted error), the teacher said "No, this occupation is _____.". If the student did not respond (no response) or responded incorrectly after the prompt (prompted error), the teacher ignored the response, waited a 3-5-sec intertrial interval, and presented the next trial.

Non-future Photograph Condition. The non-future condition was identical to the future condition with the exception of the consequent event following correct responding. Correct responses (prompted and unprompted) resulted in praise alone; the teacher did not show the printed word.

Word Instruction. Following acquisition of the photographs and a second probe condition, students were taught using progressive time delay to read two sets of four words: one set of words shown by the teacher during photograph instruction (future words) and one set of words that had not been presented (non-future words). The trial sequence and criterion were identical to that used in photograph instruction. If a student had acquired a word through training on the photographs and/or through incidental presentation of the word in the consequent event, that word was still taught. This was done to equalize the two sets of target stimuli across number of trials (24), exposures per stimulus (6), and session length.

Review Trials. If a student reached criterion level responding in one condition before the second, the teacher conducted two review trials in place of the instructional session. The trial sequence for review trials was identical to a progressive time delay trial from the session where criterion was met (e.g., if 6-sec delay when criterion was reached, 6 sec was used for review trials).

Experimental Design

An adapted alternating-treatments design (Sindelar, Rosenberg, & Wilson, 1985) was used to compare the effects of the incidental presentation of future target stimuli during instruction on current target stimuli. With this design, two treatment conditions were applied to different but equally difficult stimuli (e.g., two sets of photographs) in alternating experimental sessions. Following the initial probe condition to measure the percentages of correct responding to both the photographs and the words, students learned to name the occupations depicted in the photographs (current target stimuli); one set included praise and presentation of the printed word as the consequent event for correct responding and one set included praise alone. After a second probe condition, students were taught to read the words (future target stimuli). A final probe was conducted to measure maintenance of photographs and words.

Reliability

Dependent Measure Reliability. Reliability observations were conducted two to three times weekly and at least once during each experimental condition. A point-by-point method (number of agreements divided by the number of agreements plus disagreements multiplied by 100) was used to calculate interobserver agreement percentages.

Independent Measure Reliability Estimates. The teacher's adherence to written descriptions of the experimental procedures also was assessed (Billingsley, White, & Munson, 1980). These measures included recording total session length, presenting the correct target stimulus, delivering the attending cue, securing an attending response, presenting the task direction, waiting the correct response interval, delivering the prompt when appropriate, delivering the correct consequent event, and waiting the correct intertrial interval. The teacher's behavior was observed and compared to a written description of the experimental procedures. Independent measure reliability estimates were calculated by dividing the number of actual teacher behaviors by the number of planned behaviors and multiplying by 100. An estimate was calculated on each behavior, for each experimental condition, across all students.

Results

Reliability

Interobserver reliability on student responding and fidelity with the written description of the procedures occurred in 22.1% of the probe sessions, and in 30.1% of the instructional sessions. The mean percentage of agreement on student responding during probe and instructional conditions was 100% across all students. In the probe conditions, the mean percentage of agreement on procedural reliability was 100% on all behaviors and students. In the photograph instructional condition, the mean percentage of agreement was 100% on all measures across students, except for delivering the correct consequent event (mean = 99.6%, range = 97.5%-100%). In the word instructional condition, the mean percentage of agreement was 100% on all variables, with the exception of waiting the correct delay interval (mean = 99.8%, range = 98.6%-100%).

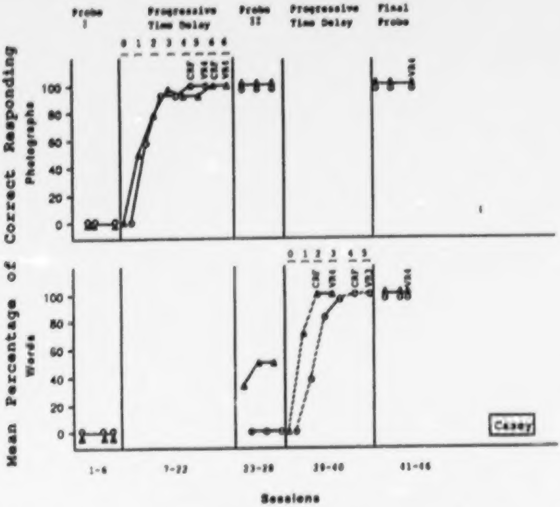

Fig. 1. The percentages of correct unprompted responding by Casey for both photographs and words during probe and instructional conditions. The percentages of correct unprompted responses to photographs and words assigned to the future condition are represented by closed triangles. The percentages of correct unprompted responses to photographs and words assigned to the non-future condition are represented by open circles.

Photograph Instruction

Effectiveness. The mean percentages of unprompted correct responding on photographs and words for Casey, Ada, Deanna, and Tom are shown in Figures 1, 2, 3, and 4, respectively. As shown, all students performed at 0% across untrained target stimuli in Probe I. During instruction on photographs, Casey, Ada, and Deanna increased to criterion level without any procedural modifications. However, because Tom continued to wait for the prompt, differential reinforcement was implemented in the non-future condition after 11 sessions of instruction. Unprompted correct responses were followed with praise and prompted corrects were followed by the teacher waiting the intertrial interval and presenting the next trial. This modification was effective in establishing criterion level performance for Tom. In Probe II, criterion level performance on the occupation photographs was maintained for Casey and Deanna across three probe ses-

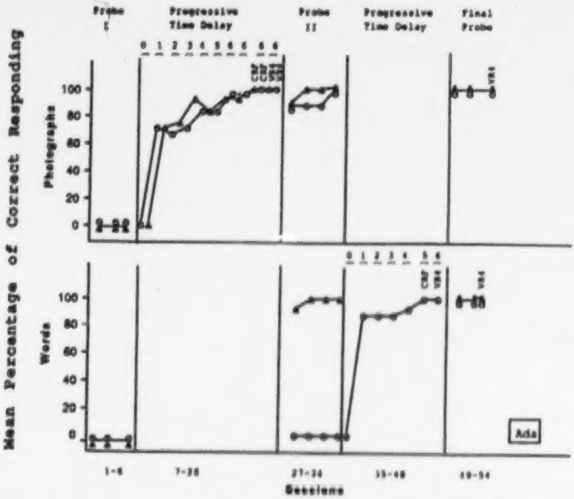

Fig. 2. The percentages of correct unprompted responding by Ada for both photographs and words during probe and instructional conditions. The percentages of correct unprompted responses to photographs and words assigned to the future condition are represented by closed triangles. The percentages of correct unprompted responses to photographs and words assigned to the non-future condition are represented by open circles.

sions. For Ada, one additional session was conducted, and she responded at 100% across the final three sessions on photographs from the future condition and 100% in the fourth session on non-future photographs. Tom responded at 100% across all probe sessions on the future photographs and 100% in five of the six sessions on photographs from the non-future condition.

Efficiency. The number of instructional sessions, trials, errors, percentage of errors, and amount of direct instructional time through criterion for each student are presented in Table 3. Minimal differences existed in these measures between the two conditions (future and nonfuture) for teaching photographs. Differences were seen only for Tom; he reached criterion level performance more rapidly in the future condition. Although each student made errors during photograph instruction, each of the conditions was near errorless; the mean percentage of errors across students in the future and non-future conditions was .9% and 1.3%, respectively.

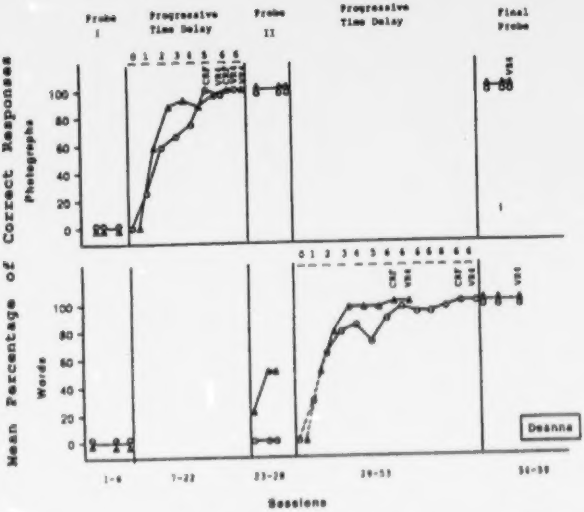

Fig. 3. The percentages of correct unprompted responding by Deanna for both photographs and words during probe and instructional conditions. The percentages of correct unprompted responses to photographs and words assigned to the future condition are represented by closed triangles. The percentages of correct unprompted responses to photographs and words assigned to the non-future condition are represented by open circles.

Although there were no differences between conditions across these traditional measures of efficiency, the future condition was more efficient in terms of its effect on the acquisition of future target stimuli across students. Based on data from Probe II, the use of progressive time delay in teaching photographs and the incidental presentation of words in the future condition resulted in each of the students learning some of the words; Casey and Deanna acquired two words, and Ada and Tom learned all four of the printed words presented in the future condition. Tom also learned each of the words assigned to the non-future condition.

Word Instruction

Effectiveness. The mean percentages of correct responding for the words also are presented in Figures 1, 2, 3, and 4. As with the photographs, all students performed at 0% across the untrained target words in Probe I.

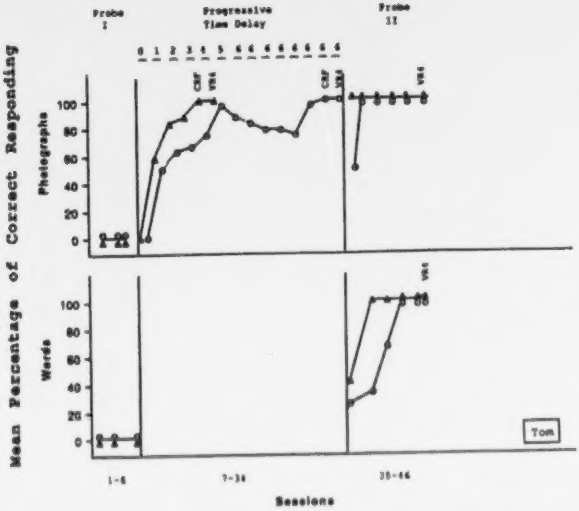

Fig. 4. The percentages of correct unprompted responding by Tom for both photographs and words during probe and instructional conditions. The percentages of correct unprompted responses to photographs and words assigned to the future condition are represented by closed triangles. The percentages of correct unprompted responses to photographs and words assigned to the non-future condition are represented by open circles.

Following photograph instruction, student performance on the words was measured. Based on Probe II data, Casey, Ada, and Deanna received instruction using progressive time delay on the two sets of words (future and non-future). During this instructional condition, the newly acquired words were intermixed with the unknown words. As shown in the Figures, progressive time delay was effective in teaching two words from the future condition and four words from the non-future condition to both Casey and Deanna, and also four words from the non-future condition to Ada. Because Tom's performance was at criterion level across both sets of four words in the final three sessions in Probe II, he did not receive instruction on the words. Casey, Ada, and Deanna maintained criterion level responding on the photographs and words in the final probe condition.

Efficiency. The traditional efficiency measures for students during word instruction also are presented in Table 3. Although the number of trials and exposures during instructional sessions were equal across the two sets of words, the number of unknown stimuli in each set varied. As a

Table 3. Efficiency Measures for Experiment I

Experiment	Number of sessions		Number of trials		Number of errors		Percent of errors		Minutes of direct instruction	
Student Condition:	Future	Non-future	Future	Non-future	Future	Non-future	Future	Non-future	Future	Non-future
Experiment I: Photographs										
Casey	8	6	192	144	2	0	1.0	0.0	32	19
Ada	9	10	216	240	3	7	1.4	2.9	32	31
Deanna	8	8	192	192	2	2	1.0	1.0	29	28
Tom	6	14	144	192	0	3	0.0	0.9	22	40
Experiment I: Words										
Casey	4	6	96	144	0	1	0.0	0.7	11	16
Ada	—	7	—	168	—	5	—	3.0	—	19
Deanna	8	13	192	312	2	11	1.0	3.5	20	39
Tom	—	—	—	—	—	—	—	—	—	—
Total across conditions	43	64	1,032	1,536	9	29	0.9	1.9	146	-192

result, no direct comparisons across efficiency measures can be made for word instruction.

Included in this table are the total numbers for all efficiency measures summed across students for each condition, which were needed in establishing criterion level performance for both words and photographs. Although the future condition was more efficient than the non-future condition across the total numbers on all efficiency measures, the results were mixed for individual students. For Casey, there were no differences between the two conditions; he learned four photographs and four words assigned to each condition in the same number of trials and sessions, with minimal differences in errors and instruction time. For Ada and Deanna, the future condition was more efficient than the non-future condition across all measures. Although, the future condition was more efficient than the non-future condition for Tom in photograph instruction, he acquired both the future and non-future word sets.

Discussion

For Experiment I, two findings are apparent. First, presentation of future target stimuli (i.e., words) in the consequent events during photograph instruction did not interfere with the efficiency of the progressive time delay procedure. That is, the students learned both sets of photographs (i.e., those with the word plus praise presented in the consequent events, and those with praise only) in about the same number of trials, sessions, errors, and minutes of instructional time to criterion. Second, analysis of the efficiency of the future condition (i.e., photograph instruction with words presented in consequent events *and* later word instruction on those words) and the non-future condition (photograph instruction without word presentation *and* later word instruction on the words depicted in the photographs) suggests that the future condition was more efficient. That is, students learned to name the photographs and read the words in the future condition more efficiently than in the non-future conditions where words were not shown for correct photograph naming. An equal amount of learning occurred in both conditions, but the future condition required 21 fewer sessions, 504 fewer trials, and 46 fewer minutes of instructional time than the non-future condition. Further, the error percentage in the future condition was about half as high as the non-future condition. Further discussion of Tom's performance is presented in the General Discussion section. The purpose of Experiment II was to replicate Experiment I with a different teacher, students, behaviors, and setting.

EXPERIMENT II

Method

Participants and Setting

Participants in Experiment II included four students (1 female and 3 males), ranging in age from 6 years 10 months to 11 years 1 month, who were enrolled in a public school classroom for students with moderate disabilities. The entry level criteria were identical to those in Experiment I. Additional information about each student is shown in Table 1.

Experimental sessions were conducted by the teacher in the students' self-contained classroom (6.4 m × 8.9 m) in a public elementary school. Sessions were conducted at a semicircular table in a corner of the classroom separated from other activities by a (3 m × 4 m) partition. The teacher sat directly opposite the student during experimental sessions. Students not involved in the investigation engaged in their usual classroom activities with a teaching assistant.

Materials

Six 35 mm photographs of local restaurants were selected as the current target stimuli. Words were printed in black letters on white (10 cm × 15 cm) index cards. The words were printed as they appeared on the restaurant sign in the community. The reinforcers selected as prizes for students included small candies and a variety of small toys. The target stimuli are presented in Table 2.

Procedures

General Procedures. Experimental conditions were implemented as in Experiment I. Progressive time delay was used to teach photographs and words to students in two daily individual instructional sessions. The six restaurant photographs selected as current target stimuli were divided into two sets of three stimuli: one set for the future condition (praise plus word presentation) and one set for the non-future condition (praise only). The restaurant photographs were assigned to the two conditions based on the length of the printed stimulus (e.g., one or two words), and the beginning and ending letters (e.g., each condition contained a word that began with "w"). Following the second probe condition, progressive time delay also was used to teach students to read the words for restaurants depicted in the photographs. The assignment of stimuli to the conditions and students is shown in Table 2.

Probe Procedures. Prior to instruction, students were assessed on their ability to name the photographs and read the words depicted in the photographs. Each probe condition consisted of a minimum of six sessions; i.e., three sessions across both the photographs (current target) and words (future target). As in Experiment I, the sessions were randomly presented across days. Each individual probe session consisted of 18 trials (three trials on each of the current or future target stimuli). The probe trial sequence was identical to that used in Experiment I.

Instruction. Each instructional session consisted of 18 trials (six trials on each of three stimuli in a set). All other procedures were identical to those described in Experiment I.

Experimental Design

The design was identical to that used in Experiment I.

Results

Reliability

Interobserver reliability on student responding and the teacher's adherence to the written description of the procedures occurred in 30.9% of the probe sessions and in 44.1% of the instructional sessions. The mean percentage of agreement on student responding during probe and instructional conditions was 100% across all students. In the probe conditions, the mean percentage of agreement on procedural reliability was 100% on all behaviors and students except delivery of the correct consequent event (mean = 99.8%, range = 99.1%-100%). In the progressive time delay future and non-future conditions, the mean percentage of agreement was 100% on all measures across students except for waiting the appropriate delay interval (mean = 99.6%, range = 98.4%-100% and mean = 99.6%, range = 98%-100%).

Photograph Instruction

Effectiveness. The mean percentages of unprompted correct responding on photographs and words for Chris, Tommy, Carrie, and Jarrod are shown in Figures 5, 6, 7, and 8, respectively. All students performed at 0% across

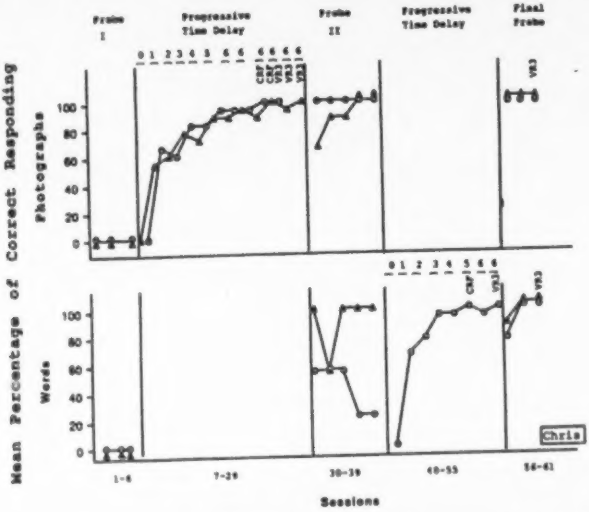

Fig. 5. The percentages of correct unprompted responding by Chris for both photographs and words during probe and instructional conditions. The percentages of correct unprompted responses to photographs and words assigned to the future condition are represented by closed triangles. The percentages of correct unprompted responses to photographs and words assigned to the non-future condition are represented by open circles.

photographs and words in the first probe condition. During photograph instruction, criterion level performance was met by all students without procedural modifications. Tommy, Carrie, and Jarrod maintained this performance on the restaurant photographs in Probe II. Chris needed two additional probe sessions before data were stable at 100% unprompted correct responding.

Efficiency. As in Experiment I, traditional efficiency measures were calculated for each student. This information is presented in Table 4. There were few differences between the two conditions during photograph instruction with the exception of (a) the number and percentages of errors for Chris and Jarrod; each student made 3 errors (1.4% and 2.8%, respectively) in the future condition and zero errors in the non-future condition, and (b) the minutes of direct instruction time; the future condition required 38 more minutes than the non-future condition.

As measured in Probe II, the procedures implemented during photograph instruction resulted in three of the four students learning some of the words; Chris learned 3 words, Carrie learned 2 words, and Jarrod

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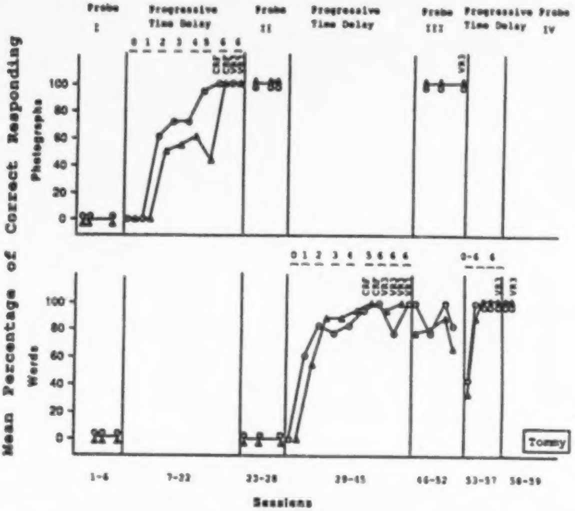

Fig. 6. The percentages of correct unprompted responding by Tommy for both photographs and words during probe and instructional conditions. The percentages of correct unprompted responses to photographs and words assigned to the future condition are represented by closed triangles. The percentages of correct unprompted responses to photographs and words assigned to the non-future condition are represented by open circles.

learned 1 of the words presented in the future condition. No student in Experiment II acquired words from the non-future condition.

Word Instruction

Effectiveness. Following Probe II, Tommy, Carrie, and Jarrod received instruction on both future and non-future sets of words. Because Chris's performance was at criterion level on the future words, he received instruction on the non-future set only. As in Experiment I, progressive time delay was effective in teaching each student to read the words depicted in the photographs. Although students maintained criterion level responding on the photographs in the final probe condition, the results were mixed for the two sets of words. Chris responded at 100% across the final two probe sessions on both word sets, Carrie responded at 100% in all sessions measuring non-future words and the final two sessions on future words,

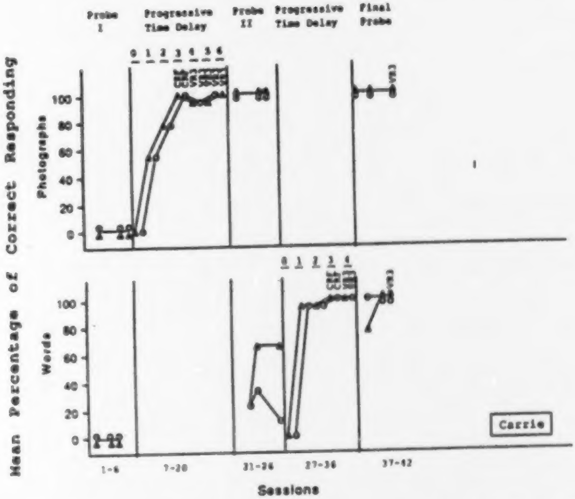

Fig. 7. The percentages of correct unprompted responding by Carrie for both photographs and words during probe and instructional conditions. The percentage of correct unprompted responses to photographs and words assigned to the future condition are represented by closed triangles. The percentages of correct unprompted responses to photographs and words assigned to the non-future condition are represented by open circles.

and Jarrod maintained criterion level responding across three sessions on words from the future condition and two sessions on the non-future words. Because Tommy did not maintain criterion level on one word from each condition, booster sessions that intermixed these two words were conducted using progressive time delay. This was effective in establishing criterion level performance.

Efficiency. Although no comparisons are made, the efficiency measures for students during word instruction also are presented in Table 4. The future condition was more efficient across total numbers of sessions, trials, and errors than the non-future condition photograph and word instructional conditions for Chris, Tommy, and Jarrod, and there were no differences between the two conditions for Carrie.

Discussion

The results from Experiment II were similar to those found in the first experiment in that (a) both instructional conditions were effective in

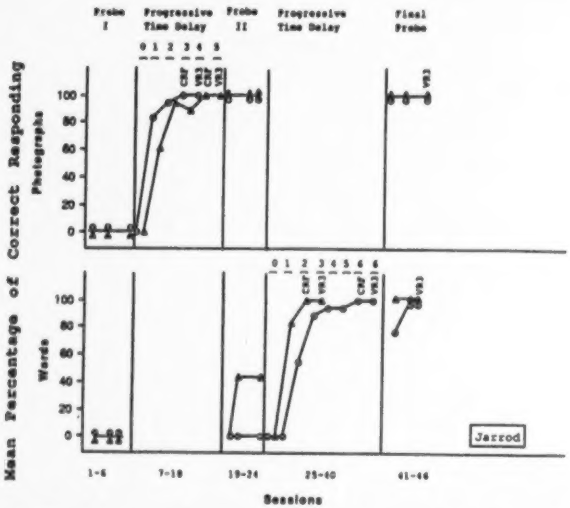

Fig. 8. The percentages of correct unprompted responding by Jarrod for both photographs and words during probe and instructional conditions. The percentages of correct unprompted responses to photographs and words assigned to the future conditon are represented by closed triangles. The percentages of correct unprompted responses to photographs and words assigned to the non-future condition are represented by open circles.

teaching four photographs to each of the students, (b) there were minimal differences between conditions across all traditional measures of efficiency, and (c) the future condition was more efficient in establishing acquisition of photographs and words combined.

GENERAL DISCUSSION

The purpose of this experiment was to determine whether presentation of words in the consequent events for photograph naming would result in more efficient acquisition of both photographs and words than when the words were not presented as part of the consequent events for photograph naming. Three findings are apparent. First, presentation of the words during the consequent events for correct responding (future condition) did not interfere with students' acquisition of the photograph names. The efficiency measures for the two photograph instructional conditions in both

Table 4. Efficiency Measures for Experiment II

Experiment	Number of sessions		Number of trials		Number of errors		Percent of errors		Minutes of direct instruction	
Student Condition:	Future	Non-future	Future	Non-future	Future	Non-future	Future	Non-future	Future	Non-future
Experiment II: Photographs										
Chris	12	10	216	180	3	0	1.4	0.0	40	24
Tommy	8	8	144	144	1	2	.7	1.4	32	23
Carrie	7	6	126	108	1	0	.8	0.0	20	14
Jarrod	6	5	108	90	3	0	2.8	0.0	18	11
Experiment II: Words										
Chris	—	8	—	144	—	3	—	2.1	—	21
Tommy	8	9	144	162	2	5	1.4	2.1	24	25
Carrie	5	5	90	90	0	2	0.0	2.2	11	12
Jarrod	4	8	72	144	0	9	0.0	6.3	9	21
Total across conditions	50	61	900	1,098	10	21	1.1	1.9	154	151

experiments are similar. This finding is of value because it sets the occasion for students to acquire additional behaviors without having to be directly taught those behaviors and it does not interfere with the behaviors "currently" receiving instruction.

Second, seven of the eight students in the two experiments learned some of the words that were presented in consequent events without direct instruction. This finding is consistent with previous research which demonstrated that students could incidentally learn "extra" behaviors inserted in consequent events (Doyle et al., 1990; Gast et al., 1990; Gast et al., in press; Wolery et al., in press). In Experiment I, two students acquired 2 of the 4 words shown in the consequent events, and two students learned all 4 words. In Experiment II, one student learned 1 of the 3 words, one learned 2 of the 3 words, and one learned all 3 words. One student, Tom, in Experiment I learned the 4 words in the non-future condition. This may have been due to the additional sessions in the non-future condition that were necessary to establish criterion level performance during photograph instruction. The combination of extensive exposure to the non-future photographs and the presentation of words in the future condition may have resulted in the discrimination that the four words were related to the four photographs. That is, Tom recognized that the task in Probe II was essentially a four-choice task. None of the other seven students in either experiment learned any of their non-future words. Thus, across the two experiments, the eight subjects learned 18 of the 25 words in the future condition and 4 of the 25 words in the non-future condition without direct instruction.

Third, the future condition was clearly more efficient than the non-future condition as measured by the number of trials, sessions, errors, percent of errors, and number of minutes of instructional time to criterion when combined for photographs and words. When these figures are summed across the two conditions, the following results are found. In the future condition, the photographs and words were learned in 32 fewer sessions, 702 fewer trials, and 43 fewer minutes of instruction. The number of errors also was less in the future condition (19 versus 50), and the error percentages were lower (0.98% versus 1.89%). It should be noted that the number of sessions and trials to criterion in the future condition may be inflated because students who had acquired some, but not all, words during photograph instruction also were taught their acquired words. For example, Casey learned 2 of his 4 words during photograph instruction in the future condition (i.e., from presentation of the word in the consequent event); however, when he participated in the word instruction, all four words were included. This was done to ensure equal session length, equal number of trials, etc., across the two conditions, future and non-future. Thus, the combined efficiency measures are a conservative estimate of the relative differences between the two conditions.

These findings suggest that presentation of future target stimuli in the consequent events of current instruction may increase the efficiency of instruction. Given the sequential nature of many curricular content areas, this finding may hold considerable value for presenting instruction. Several possibilities for future research could be addressed. Specifically, would these benefits continue to accrue if the word instruction also contained future targets in the consequent events? For example, if during the word instruction, the teacher also spelled the words in the consequent events, would students learn to spell the words without direct instruction? Another area of useful study could focus on what types of behaviors are most appropriately taught in this manner, and whether the amount and type of information presented in the consequent event influence future learning. For example, could statements of rules in the consequent event be effective in establishing rule application for similar behaviors in later learning. Future research also should determine whether other manipulations of current instruction might influence later instruction. For example, would presentation of future stimuli in the attentional cue prior to presentation of each trial in the photograph condition result in similar effects on later learning?

Two methodological issues need attention. In this study, we chose to include all words in word instruction, regardless of whether students demonstrated acquisition of some of these words during the second probe condition (i.e., immediately after photograph instruction). An alternative would have been to teach only the words that were not learned in the future condition with an equal number of words in the non-future word instruction condition. Another alternative would be to place the acquired words in review (e.g., 1 trial per session) and thereby reduce the total number of trials in the future word instruction condition. We chose the first option for two reasons. First, we conceptualized the research question as being whether the presentation of words in the consequent event for correct responses in photograph instruction would result in more rapid learning of both the photographs and words. We were interested in the efficiency of the manipulation for all photographs and all words. This was done because we suspected that the presentation of the words in the consequent event during photograph instruction might interfere with acquisition of the photograph names. This may have occurred for Chris (Experiment II); he needed 12 sessions in the future condition, as compared to 10 in the non-future condition, and required 40 minutes of instruction in the future condition, as compared to 24 in non-future. Second, we chose to include all words in the word instruction condition because we feared that word reading acquired during photograph instruction would not maintain in Probe III without some direct instruction. Although students demonstrated 100% correct responding during Probe II on some words, they had never been reinforced directly for reading those words.

The second methodological issue that needs to be addressed comes from Tom's results in Experiment I; he learned all words in both conditions (future and non-future) without direct instruction. It appears that he discovered that the words being assessed during Probe II were related to the pictures that had been taught in photograph instruction. To control for this, extra words that were similar to the words in both conditions could have been included during probes. This would have eliminated the possibility that students could simply match words to the pictures.

In summary, this study presents a prototype for assessing the effects of current instruction on future instruction. While the sequencing of curriculum content through task analysis and other procedures has been used for years to influence later learning, this study suggests that some manipulations of the instructional procedures may influence later learning. Clearly, this is an area that merits a considerable amount of research activity. Such research may advance what is known about how learning occurs and hold practical implications for how to make instruction more efficient.

ACKNOWLEDGMENTS

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Appendix J

Increasing the Efficiency of Future Learning Through Instructive Feedback

Increasing the Efficiency of Future Learning through Instructive Feedback

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Abstract

This study investigated the effects of presenting future target behaviors in the consequent event following correct responses of current target behaviors when teaching preschoolers in a small group arrangement to name numerals. A 3-second constant time delay procedure was used to train two sets of numerals. During instruction, correct responses to one set of numerals received a token, verbal praise, and presentation of the printed number word for the targeted numeral in one daily session. In the other daily session, the second set of numerals received only tokens and verbal praise. After criterion was met on both sets of numerals, children received instruction on number words corresponding to numerals in each of the previously instructed sets. An adapted alternating treatments design (Sindelar, Rosenberg, & Wilson, 1985) was used to compare the effectiveness and efficiency of the two conditions. Results indicate that (a) all children learned to name numerals in both conditions, (b) presentation of future target behaviors did not interfere with learning of numerals, (c) four of five children learned to read all number words in both conditions, and (d) the addition of number words during numeral instruction increased the rapidity with which children acquired the number words.

Increasing the Efficiency of Future Learning by Manipulating Current Instruction

Teachers of individuals with developmental delays and disabilities have a number of instructional strategies from which to choose. These include the system of least prompts (Doyle, Wolery, Ault, & Gast, 1988), progressive time delay (Charlop & Trasowech, 1991), constant time delay (Wolery, Holcombe, et al., in press), simultaneous prompting (Schuster, Griffen, & Wolery, in press), most-to-least prompting (McDonnell & Ferguson, 1990), peer-mediated strategies (Kohler & Strain, 1990), incidental teaching and other milieu strategies (Kaiser, Yoder, & Keetz, 1992), and the task-demonstration-model procedure (Repp, Karsh, & Lenz, 1990). A considerable amount of research documents that these strategies result in students of varying ages and with a wide range of disabilities learning a broad array of useful skills (Wolery, Ault, & Doyle, 1992). Based on these encouraging findings, recent research has attempted to move the analysis of instruction beyond demonstrations of effectiveness.

This research has focused on several separate but related dimensions of instruction. Some investigations have compared two or more strategies directly in terms of the rapidity with which learning occurs (i.e., sessions, trials, and minutes of instruction to criterion) (Ault, Wolery, Doyle, & Gast, 1989). Other studies have evaluated the effects of group instruction to make more efficient use of teacher time and promote opportunities for observational learning (Schepis, Reid, & Fitzgerald, 1987; Farmer, Gast, Wolery, & Winterling, 1991). Still other studies have evaluated the effects of choral versus individual responding (Wolery, Ault, Doyle, Gast, & Griffen, in press), predictable versus unpredictable orders of trial presentation (Ault, Wolery, Gast, Doyle, & Martin, 1990), interspersal of trials on known skills during instruction on new skills (Koegel & Koegel, 1986), and attentional cues (Wolery, Cybriwsky, Gast, & Boyle-Gast, 1991; Wolery, Ault, Gast, Doyle, & Mills, 1990).

In addition to this research, a number of studies have evaluated the effects of instructive feedback, which involves the presentation of additional, non-target stimuli to the consequent events (e.g., praise statements) following students' responses. In these studies, the student is presented with the target stimulus and given an opportunity to respond. After a correct response, reinforcement plus an additional, non-target stimulus is presented. Students are not required to respond to this additional stimulus. For example, when teaching a student to read a sight word, the definition of the word would be presented during teacher praise for correct responses. Instructive feedback has been effective with secondary students with moderate mental retardation (Doyle, Gast, Wolery, Ault, & Farmer, 1990) and learning and behavioral disabilities (Wolery, Cybriwsky, et al., 1991), elementary students with mild (Shelton, Gast, Wolery, & Winterling, 1991) and moderate mental retardation (Stinson, Gast, Wolery, & Collins, 1991), and preschoolers with mental retardation (Wolery, Holcombe, Werts, & Cipollone, in press). The additional stimuli have been presented verbally (Doyle et al., 1990), on a computer screen (Edwards, 1989), and verbally accompanied by a visual display on a flash card (Gast, Doyle, Wolery, Ault, & Baklarz, 1991). In each of these studies, students learned the behaviors that were taught directly and some of the additional stimuli that were presented but not taught directly.

One study evaluated the effects of instructive feedback during initial instruction on students' learning in later instruction (Wolery, Doyle, et al., 1991). Initially, students were probed on their ability to name two sets of photographs and read words of the entity depicted in those photographs. The students were then taught to name the two sets of photographs during separate, daily sessions. One set of photographs was taught without instructive feedback; and the second set was taught with instructive feedback which involved showing a flash card with a written word of the entity depicted in the photograph. After students achieved criterion level performance on photograph naming, they were assessed on their ability to name all photographs and read the written words. They were then taught (in separate daily sessions) to read the words for all photographs (i.e., those words they had been shown during previous instruction and those that corresponded with the photographs but had not been shown). The results suggested that adding the written word to the consequent events during photograph-naming instruction was an effective means of increasing the efficiency of future instruction when the words were taught directly.

However, this study had a number of limitations. First, progressive time delay was used. Progressive time delay is more complex than constant time delay, but studies directly comparing the two have shown minimal differences in the rapidity of learning (Precious, 1985; Ault, Gast, & Wolery, 1988). Generally, more parsimonious procedures should be used when learning is not differentially affected. Second, the students in this study had a history of direct instruction with naming pictures and reading words. This frequently is not the case with many young children. Third, the students were taught in one-to-one instruction. Such instruction is frequently impractical in schools and precludes the opportunity for observational learning. Fourth, students were only assessed on word reading for words that corresponded to the pictures taught. Thus, students may have "guessed" which words were identical rather than learned to read the words.

The purpose of the present study was to address these limitations. Constant time delay was used to teach preschoolers with developmental delays to name numerals and read number words. Two sets of numerals were taught first in separate daily sessions, and half the numerals were taught with instructive feedback (i.e., showing a flash card with the corresponding number word) and half were taught without instructive feedback. After criterion performance was established on numerals, the students were taught to read the number words that corresponded with all of the numerals. The students had no experience with constant time delay or instructive feedback, and none had received systematic instruction on the behaviors being taught. A small group format was used to evaluate the occurrence of observational learning. Also, words (called control words) with stimulus characteristics similar to the target words were used during probes to minimize the possibility of students' guessing the correct responses.

Method

Participants

Five preschool students participated in this study. Students had no prior experience with any direct instructional procedure. In addition, students had received no systematic instruction on numerals or written words. Descriptive information of the students is presented in Table 1.

Insert Table 1 about here

All students met the following prerequisite skills: (a) ability to wait 4 seconds for a prompt when shown abstract line drawings and given the directions prior to the trial presentation, "If you don't know what the picture is, wait and I will tell you."; (b) ability to match to sample numerals when presented with a 3-choice array within 3 seconds of the task direction, "Which one is the same?"; (c) ability to match to sample number words when presented with a 3-choice array within 3 seconds of the task direction, "Which one is the same?"; (d) ability to imitate the instructor's verbal model within 3 seconds when provided with the task direction, "I want you to say the same thing that I say."; (e) intact auditory and visual systems required to see and hear all relevant stimuli as measured by direct observation of the student in circle time activities responding correctly to known questions and picture presentations; and (f) the ability to sit and attend to an instructor in the presence of two other children for 10 minutes.

Setting

This study was conducted in a preschool program for children with developmental delays. The classroom consisted of 8 children and 1 teacher. All experimental sessions for the two groups were conducted in the classroom at two tables designated for instructional activities. Screening, observational learning probes, and probe sessions were conducted in a one-to-one arrangement in the classroom by the investigator. The classroom teacher supervised all other children in the classroom while the investigator conducted the individual screening and probe sessions.

All instructional sessions were conducted in a group arrangement. The classroom teacher conducted instructional sessions with Group A (Eric, Chris, and Scott), and the investigator conducted instructional sessions with Group B (Paul and Jason). Both groups received two instructional sessions a day. During any session there was never more than three students in the classroom who were not participating in the study. These students were engaged in typical classroom activities.

Materials

Instructional materials consisted of sets of white index cards (4 in x 6 in) with a numeral printed 1 in. in height in the center on one side of the card and the word for that numeral printed 1 in. in height on the opposite side of the card. Each student had 4 targeted numerals and corresponding number words. Each student had a laminated index card (5 in x 8 in) with their name printed at the top and circles drawn below which served as token cards. A variety of stickers and small tangibles served as reinforcers. Target stimuli are presented by condition and student in Table 1.

Procedures

General procedures. Students were initially screened to identify unknown numerals, corresponding number words, and control words. The numerals and corresponding number words for each student were matched on stimulus characteristics and assigned to two conditions, called future and nonfuture (described below). Two numerals and corresponding number words were assigned to each student for each condition. Each student in Group A had unique targeted stimuli; students in Group B shared one stimulus in each condition with the remaining stimulus being unique to each student.

The future condition involved (a) instruction with a 3-second constant time delay procedure in naming numerals plus the presentation of the corresponding number word during the consequent events for correct responding; and (b) after criterion level performance was established, direct instruction with a 3-second constant time delay procedure in reading the corresponding number words. The nonfuture condition involved (a) instruction with a 3-second constant time delay procedure in naming numerals, and (b) after criterion level performance was established, direct instruction with 3-second constant time delay procedure in reading the corresponding number words. The future and nonfuture conditions were identical except that during numeral instruction for the future condition the number word was shown to students during the consequent events for correct responses.

Probe procedures. All probe sessions were conducted by the investigator in a 1:1 instructional arrangement. Separate probe sessions were conducted for numerals and words. Both numerals and words were probed in three sessions across three days. For both Group A and Group B, target numeral probe sessions consisted of 4 trials per numeral (16 trials) and an additional 4 trials of a known letter for a total of 20 trials per session. Word probe sessions consisted of 3 trials per number word (12 trials) and 2 trials per control word (8 trials) for a total of 20 trials per session.

In all probe sessions, the following trial sequence was used. The investigator secured the student's attention by stating, "(Student's name), look." and simultaneously holding up the numeral or word card. If the child did not attend, the attentional cue was repeated while the investigator touched the student's arm. When attention had been secured (i.e., child looked at the card), the investigator presented the task direction "What is this?" and provided a 4-second response interval. Correct responses were followed by verbal praise on a CRF schedule and appropriate attending to materials was followed by verbal praise on a VR3 schedule. Errors and no responses were ignored. The intertrial interval was 2-4 seconds in duration. The following sequence was used during probe conditions: (a) Day 1 - observational test of numerals, target/control word probe, target numeral probe, (b) Day 2 - observational test of words, target numeral probe, target/control word probe, and (c) Day 3 - target numeral probe and target control/word probe.

Observational learning probes. Observational learning of both numerals and number words was assessed in a 1:1 instructional arrangement in the form of a pretest, midtest, and posttest. Observational numerals and number words were probed in separate sessions during the probe conditions as described in the preceding paragraph. For students in Group A, observational tests consisted of two trials per stimulus and 16 trials per session. For students in Group B, observational tests consisted of 5 trials per stimulus and 10 trials per session. The trial sequence was identical to that used during target probes.

Constant time delay. A 3-second constant time delay procedure was used to teach all stimuli. Instructional sessions for Group A and Group B consisted of 6 trials per stimulus and 12 trials per student. A 0-second delay interval was implemented for the first session of each instructional condition. All subsequent sessions employed a 3-second delay interval. If three days elapsed without instruction following the initial 0-second delay session, the 0-second delay trials were repeated for an additional session.

The following trial sequence was used for 0-second instructional sessions. The teacher secured the student's attention by saying, "(Student's name), look." and simultaneously held up the numeral card. If the student did not look, the teacher repeated the verbal cue while touching the student's arm. Once the student looked at the card, the teacher stated the task direction, "What is this?", and immediately presented the controlling prompt (verbal model). After presentation of the controlling prompt, a 3-second response interval was provided followed by the appropriate consequent event, a 2- to 4-second intertrial interval, and the next trial. Correct responses (i.e., imitation of the verbal model) resulted in verbal praise and a slash on the token card. Error and no responses resulted in the teacher telling the student to repeat what she says. The teacher then repeated the controlling prompt. Students selected a tangible reinforcer at the end of the session if they had twelve slashes on the token card.

All sessions following the initial 0-second delay session employed a 3-second delay interval. The trial sequence was identical to the 0-second trials except that a 3-second response interval was inserted between the task direction and delivery of the controlling prompt. Correct responses before and after the prompt received verbal praise and a slash on the token card. Incorrect responses before the prompt received the verbal mand "If you don't know, wait." and removal of the target stimulus followed by the intertrial interval. Incorrect responses after the prompt and no responses resulted in the removal of the target stimulus followed by the intertrial interval and the next trial. If a student had twelve slashes on his token card at the end of the session, he selected a tangible reinforcer. Instruction continued until criterion level responding was established in each condition. Criterion was two consecutive group sessions at 100% CRF and two consecutive group sessions at 100% VR3.

Future numeral condition. In the future condition, correct responses before and after the prompt resulted in verbal praise and a slash on the token card paired with the simultaneous presentation of the corresponding written number word for the targeted numeral. The word was presented for the duration of the verbal praise (approximately 2 seconds). All student statements concerning the presentation of the written word in the consequent event were ignored, and the instructor made no comments about the word.

Nonfuture numeral condition. In the nonfuture condition, correct responses resulted in verbal praise and a slash on the token card only. The corresponding number word was not presented. On all other variables, the nonfuture condition was identical to the future condition.

Review trials. If all members of a group displayed criterion level performance in one condition prior to the alternate condition, review sessions were conducted for the first condition until performance in the alternate condition reached criterion. During review sessions, each student was presented with one trial of their target stimuli. Review sessions consisted of two trials per student. The trial sequence for review trials was identical to the trial sequence for 3-second delay trials. Reinforcement was thinned from a variable ratio of three trials during the last criterion session to a fixed ratio of two trials.

Number word instruction. Following the second probe condition, constant time delay was implemented to train the corresponding number words to each student. The number words were divided into two sets (future words and nonfuture words), with the trial sequence identical in both conditions and identical to the nonfuture numeral instructional condition. If a student had acquired a word during the numeral training, that word received one review trial per session during number word instruction.

Experimental Design

An adapted alternating-treatments design (Sindelar et al., 1985) was used to compare the effects of presenting future targeted words in the feedback events and of not presenting the future words in the feedback events. In the adapted alternating-treatments design, two treatments are applied to independent behaviors. It is essential to the design that these behaviors be equal in regard to the level of difficulty. In this investigation, behaviors to be acquired included two sets of numerals and two sets of number words. Targets were chosen for instruction if (a) expressive identification of the numeral was 0% across all trials, (b) match-to-sample of the numeral was 100% across all trials, (c) match-to-sample of the number word was 100% across all trials, and (d) expressive identification of the written word was 0% across all trials. Once the target stimuli were selected, they were counterbalanced across the two instructional conditions (future and nonfuture). Counterbalancing was based upon the topographical similarities of the numerals, number of digits in the numerals, number of letters in the written word, subjects' ability to identify the unknown numeral as a quantity, subjects' ability to rote count to the target number correctly, and subjects' ability to expressively state numerals as quantities in response to tangible objects. Following the selection of target numerals and corresponding number words, a control word was paired with each targeted number word. The following guidelines were used in the selection of the control words: (a) same initial letter, (b) same number of letters (plus or minus one letter on words greater than four letters), (c) topographically similar, (d) not comprised of the same letters (no anagrams), and (e) unknown to the subject. All variables which did not remain constant (e.g. time of day) were counterbalanced and alternated across training sessions to control for both order and sequencing effects.

Reliability

Procedural reliability data and interobserver agreement data were collected by the investigator and a trained observer across at least 33% of the experimental sessions. A point-by-point method (number of agreements divided by the number of agreements plus the number of disagreements multiplied by 100) was used to calculate inter-observer agreement percentages. Procedural reliability data were calculated by dividing the number of actual teacher behaviors by the number of planned teacher behaviors and multiplying by 100 (Billingsley, White, & Munson, 1980). Data were collected on the following instructor behaviors: presenting the attentional cue, ensuring the child's attention was secured, presenting the task direction, waiting the appropriate response interval, presenting the controlling prompt, providing the appropriate consequent event, presenting the target number word (future condition of numeral instruction only), and waiting the intertrial interval.

Results

Interobserver Agreement and Procedural Fidelity

Dependent measure reliability. Interobserver agreement data were collected in 37% of the probe sessions for each student, 37% of the numeral instructional sessions and 36% of the number word sessions for Group A, and 36% of the numeral sessions and 33% of the number word sessions for Group B. The percent of agreement in each session for each student was 100.

Procedural reliability. Procedural reliability data also were collected in 37% of the probe sessions for each student, 37% of the numeral instructional sessions and 36% of the number word sessions for Group A, and 36% of the numeral sessions and 33% of the number word sessions for Group B. Procedural reliability during all probe sessions for all students was 100%. Procedural reliability during all instructional sessions for each teacher behavior was 100% with the following exceptions: (a) for the future numeral condition, the percent of correct implementation for ensuring the attending cue for Chris and Paul was 99 (96-100) and 98 (92-100), respectively, and for presenting the future stimulus for Scott it was 99.7 (97-100); (b) for the nonfuture numeral condition, the percent of providing the task direction for Scott was 99.6 (96-100); (c) for the future number word condition, the percent of providing the task direction for Scott was 99.6 (96-100) and of ensuring the attending cue for Jason was 99 (96-100); and (d) for the nonfuture number word condition, the percent of presenting the attending cue was 99.7 (97-100) and 99 (96-100) for Eric and Paul, respectively.

Effectiveness

The percent of correct responses for probe and the future and nonfuture numeral and number word conditions are shown in Figures 1, 2, 3, 4 and 5 for Eric, Chris, Scott, Paul, and Jason, respectively. Prior to instruction with constant time delay, no child responded correctly during the Probe I condition on numerals, target number words, or control words. Introduction of training in both conditions (future and nonfuture) for numerals resulted in all children acquiring the target numerals at criterion levels. Chris was placed in Probe II conditions prior to reaching the group criterion because of the possibility that his mother would remove him from the preschool. No procedural manipulations were necessary for Eric, Chris, Paul, and Jason; however, Eric consistently produced fewer errors in the first daily session regardless of the instructional condition (i.e., future or nonfuture). Two procedural manipulations were necessary for Scott. On the 20th session, differential reinforcement for correct unprompted responses was instituted; unprompted correct responses resulted in praise and delivery of a token, and prompted correct responses resulted in praise. This modification resulted in 100% unprompted correct responses in the future but not nonfuture condition. Thus, a match-to-sample attending response was introduced in both conditions and resulted in criterion level performance. For numerals for all students, 100% correct performance occurred in the Probe II condition.

Insert Figures 1, 2, 3, 4, and 5 about here

As noted above, none of the students responded correctly to the number words in the Probe I condition. During Probe II, three sessions on all target behaviors occurred before spring break and one after spring break. No student responded correctly to the nonfuture number words or to any of the control words. During the first three sessions of Probe II, Eric responded correctly to both future number words (i.e., those presented during the feedback events during numeral instruction). Following spring break, he responded correctly to all trials of one number word from the future condition and none of the trials for the second word. During the first three sessions of Probe II, Chris responded incorrectly in the first session to all number words; during the second session with future number words, he was correct on 67% of the trials (i.e., all trials for one word and one trial for the second word); and during the third session, he responded correctly on 50% of the trials (i.e., all trials for one word). After a two week absence, he responded correctly to none of the words in the fourth Probe II session. Scott did not respond correctly to any number words during Probe II. Paul responded correctly to one future number word during the first session of Probe II, but thereafter responded incorrectly to all number words. Jason did not respond correctly to any of the number words during Probe II.

After Probe II, constant time delay training was implemented for all target number words (future and nonfuture). For Eric, the one number word to which he always responded correctly during Probe II sessions was given only one trial interspersed with instructional trials on his second word. However, during the first five sessions, he did not maintain correct performance on the previously acquired number word; therefore, the number of trials for that word was increased to six per session. As a result, he acquired all words at criterion levels. During Probe III, Eric maintained 100% correct performance on all numerals and target number words, and performed at 0% correct on all control words. Chris met criterion on all number words without modification of procedures. During Probe III, he was 100% correct on all numerals and target number words and had 0% correct performance on control words. For Scott, procedural modifications were required during number word instruction. These included a match to sample attending response as used with numerals. However, errors continued on two number words, one from each condition. The match to sample attending cue was modified to use these two numerals (in both conditions) as the distractor. Finally, differential reinforcement was used for unprompted and prompted correct responses. These modifications resulted in Scott achieving criterion level performance in the future number word condition, but not in the nonfuture condition. Instruction was stopped due to the end of the school year. However, during Probe III, Scott responded at 100% correct responses for all target words and numerals and responded at 0% correct on all control words. Paul and Jason achieved criterion level performance in both number words conditions without procedural modifications. Their Probe III performance was 100% correct responding to all numerals and target number words and 0% correct on all control words.

Efficiency

A primary purpose of the study was to determine whether the presentation of number words during the feedback events of numeral instruction would influence the rapidity of learning the number words. Data on the number of sessions, the number and percent of errors, and the number of minutes of instruction through criterion for numeral and number word instruction for the two conditions (future and nonfuture) are shown in Table 2.

Insert Table 2 about here

As shown in Table 2, the number of sessions to group criterion for numeral instruction in the future and nonfuture conditions were equivalent. Similarly, the number of minutes of instruction were similar. The mean session length for the numeral future condition was 5 minutes, 13 seconds; the mean session length for the numeral nonfuture condition was 5 minutes, 9 seconds. These data indicate that the addition of the number word during feedback events for correct responding did not increase the number of sessions to criterion and did not increase substantially the length of the sessions.

When instruction was implemented for the number words, all five students acquired the number words in the future condition (i.e., those that had been presented in the feedback events during numeral instruction); but only four of the five students acquired the number words in the nonfuture condition. Scott, the student who did not acquire the number words in the nonfuture condition, however, did respond correctly to the number words in the final probe condition. Thus, his data are included in the analysis of the rapidity of learning. In terms of sessions to criterion, all students required fewer sessions to criterion in the future condition as compared to the nonfuture condition. Summed across students, the future condition required 77 sessions and the nonfuture 89 sessions. Similar differences were found for the number of minutes of instruction. Four of the five students required fewer minutes of instruction in the future word condition than in the nonfuture word condition; for the fifth student, Chris, the number of minutes were equivalent. Summed across students, the future condition required 309 minutes of instruction, and the nonfuture condition required 377 minutes of instruction. The mean session length for the future condition was 4 minutes, and the mean session length for the nonfuture condition was 4 minutes and 15 seconds. Thus, based on the data presented in Table 2, it appears that the presentation of the number words during feedback events for correct responding during numeral instruction decreased the number of sessions and minutes needed to reach criterion when words were taught directly. Interestingly, for the students who met criterion in all conditions, the number of sessions and number of minutes of instruction to criterion were less for the word condition than for the numeral condition. This was true across both future and nonfuture conditions.

Observational Learning

During each probe condition, students were individually assessed on expressive naming of the other group members' target numerals and number words. Observational numerals and number words were assessed in one separate probe session per probe condition. These probes were referred to as pretest (Probe I condition), midtest (Probe II condition), and posttest (Probe III condition).

The percentages of correct responses for observational learning of numerals are shown in Table 3. During the pretest, Eric, Chris, and Paul responded correctly to the numerals taught to their peers. The midtest data indicate that Eric, Chris, and Jason acquired their peers' target numerals; however, this was not differentially affected by the future or nonfuture conditions. Eric, Chris, Paul, and Jason maintained 100% correct responding on all observational numerals during the posttest. Scott did not respond correctly to any observational numerals during the posttest.

Insert Table 3 about here

The percent of correct responses for observational learning of number words also are shown in Table 3. During the pretest, no student responded correctly to the number words. During the midtest, Eric responded correctly to 50% of the number words in the future condition (i.e., those shown to his peers during feedback events for correct responding during the numeral instruction). None of the other students responded correctly during the midtest. During the posttest, Eric responded correctly to 50% of the number words from the future condition, and 25% of the number words in the nonfuture condition. Chris responded correctly to 50% of the number words from the future condition, and none in the nonfuture condition. Scott did not respond correctly to any of the words in the posttest; Paul responded correctly to all words in the posttest; and Jason responded correctly to all the future words but none of the nonfuture words. These data provide tentative support for the notion that the future condition produced greater observational learning of the number words for at least three of the students.

Discussion

This study assessed the effects of presenting number words in the consequent event for numeral instruction on acquisition of both numerals and number words. Based on the results several findings merit discussion. First, implementation of constant time delay resulted in all five students learning to expressively identify numerals and four of five students learning to expressively identify number words. For the fifth student, the end of the school year prevented criterion being met in the nonfuture condition; however, this student performed at 100% on the final number word probe suggesting that all behaviors were essentially learned. In addition, behaviors were acquired although no student had a history with constant time delay or any direct instructional strategy.

Second, number words were acquired more efficiently than numerals suggesting that learning to learn may have occurred. Nonfuture numerals were acquired in 108 sessions while nonfuture number words were acquired in 89 sessions across all subjects. Additionally, future numerals were acquired in 108 sessions and future number words were acquired in 77 session across all subjects. This is similar to other studies (e.g., Godby, Gast, & Wolery, 1987); although, it is difficult to document in this study because of differences between the stimuli (numerals and number words).

Third, addition of the number word to the consequent event during future numeral instruction did not interfere with acquisition of the numerals. This is consistent with findings of previous research (Wolery, Doyle, et al., 1991). In three of five students, number and percentage of errors through criterion were lower in the future condition. Future numeral instruction resulted in 8 additional minutes (i.e. mean of 4 seconds per session) of instructional time across all subjects and sessions.

Fourth, the addition of the number word to the consequent event for numeral instruction resulted in more rapid learning (i.e., sessions and minutes through criterion) of number words. Future number words required 87% of the sessions needed to acquire the nonfuture number words. Thus, if one session were conducted each day, the teacher would gain an extra session for teaching some other skill every two weeks. Similarly, the future number words required 82% of the minutes of instruction needed to acquire the nonfuture number words. This represents a savings of slightly more than 10 minutes for every hour of direct instruction. Thus, for each 6-hours of direct instruction, a savings of one hour would accrue. Such differences constitute considerable savings of instructional time for other activities. It should be noted that the apparent increase in observational learning as a result of including the number word in the numeral instruction was not calculated into these figures. Thus, the savings represented by the manipulation may be greater than reported.

Finally, observational learning occurred for both numerals and number words in some students. The addition of the number word to the consequent event for numeral instruction may increase observational learning of number words when they are directly taught. For three of the five students observational learning of future number words was greater than learning of nonfuture number words. For the remaining two students there were no differences between the two conditions. Differences between observational learning in the two procedures deserves further investigation.

Based on the findings of this study and those of Wolery, Doyle, et al. (1991), tentative support exists for recommending that teachers present future target stimuli during current instruction. The addition of the future target stimuli does not appear to interfere with the acquisition of the behaviors currently being taught, but does appear to result in more rapid learning of those stimuli when they are subsequently taught.

In continuing this line of research at least four issues deserve attention. First, the effects of this intervention should be investigated with additional students with more varied tasks. To date, the effects of adding future target stimuli to current instruction has been studied only with naming photographs and reading words corresponding to those photographs (Wolery, Doyle, et al., 1991) and naming numerals and reading words corresponding to those numerals (i.e., this study). The effects of this manipulation on other types of behaviors deserves immediate research attention.

Second, the effects of calling attention to the stimulus that is presented in the feedback events should be studied. For example, the teacher could say, "this is also (number)" during the praise statement; or, the number words could be presented in highly varied formats (e.g., different colors, sizes, and on different backgrounds). Such studies should determine whether these manipulations interfere with the acquisition of the behaviors being taught and whether they differentially influence the rapidity of future learning.

Third, the use of specific and group attending cues should be investigated. In this study, a general attending cue was required only of the student receiving the trial (i.e., the student was asked to look at the card). However, Wolery, Cybriwsky, Gast, and Boyle-Gast (1991) found that specific attending cues/responses increased the amount of observational and incidental learning; and Wolery et al. (1990) found that group attending responses increased observational learning. Additional research should evaluate the effects of these variations on the amount of observational learning that occurs for the behaviors being directly taught to peers and the stimuli presented in the feedback events for peers.

Fourth, future research should focus on using this manipulation repeatedly across sets of stimuli. For example, during instruction on numeral naming (i.e., as in this study), the number word could be presented in the feedback events. During subsequent direct instruction on word reading, students could be told the sequence of letters in the feedback events (i.e., for teaching spelling) (cf. Gast, Doyle, Wolery, Ault, & Baklarz, 1991). During subsequent direct instruction on spelling, students could be shown coins whose values equaled the word being spelled. Such studies would allow the manipulation to be evaluated when it is used repeatedly.

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Table 1

Student Demographics, Target Behaviors and Control Behaviors by Instructional Condition

Group Child	CA[a]	Disability	Developmental Ages							Target Behaviors and Control Behaviors	
			SC[b]	AD[b]	MT[b]	CM[b]	CG[b]	RL[c]	EL[c]	Future[d]	Nonfuture[d]
Group A											
Eric	54	Developmental/ Language Delay	52	51	50	41	55	60	53	11-eleven/elect 15-fifteen/flicker	12-twelve/tither 17-seventeen/somewhere
Chris	56	Developmental/ Language Delay	54	49	53	33	53	39	39	2-two/toe 9-nine/near	5-five/fawn 10-ten/tie
Scott	55	Developmental/ Language Delay	37	45	47	43	42	41	52	1-one/our 7-seven/seems	4-four/fear 6-six/sea
Group B											
Paul	42	Developmental/ Language Delay	31	24	30	27	41	42	37	6-six/sea 11-eleven/elect	9-nine/near 12-twelve/tither
Jason	60	Seizure Disorder/ Developmental/ Language Delay	38	35	43	43	36	54	43	6-six/sea 4-four/fear	9-nine/near 2-two/toe

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[a] CA = Chronological Age.

[b] Developmental Age scores were derived from the Batelle Developmental Inventory (Newborg, Stock, Wnek, Guidubaldi, & Svinicki, 1984). SC = Social, AD = Adaptive, MT = Motor, CM = Communication, CG = Cognitive.

[c] Developmental age scores were derived from the Preschool Language Scale (Zimmerman, Steiner, & Pond, 1979).

[d] Target numeral, corresponding target number words, and control word.

Table 2

Number of Sessions, Number and Percent of Errors, and Minutes of Direct Instruction Through Criterion

Stimuli	Number of Sessions		Number of Errors		Percent of Errors		Minutes of Instruction	
Student	Future	Nonfuture	Future	Nonfuture	Future	Nonfuture	Future	Nonfuture
Numerals								
Eric	31	31	14	22	3.8	5.9	174	171
Chris	17	17	1	10	0.5	4.9	109	104
Scott	32	32	14	28	3.7	7.3	178	175
Paul	17	17	0	0	0.0	0.0	57	59
Jason	11	11	0	1	0.0	0.7	46	47
Total	108	108	29	61	2.2	4.7	564	556
Number Words								
Eric	12	15	4	4	3.2	2.2	55	81
Chris	11	12	0	4	0.0	3.3	52	58
Scott[a]	29	(32)	8	(16)	2.3	(4.4)	126	(146)
Paul	12	15	0	0	0.0	0.0	37	46
Jason	13	15	1	1	0.6	0.5	39	46
Total	77	89	13	25	1.4	2.3	309	377
GRAND TOTAL	185	197	42	86	1.9	3.6	873	933

[a] Scott did not reach criterion in the nonfuture number word condition; however, he responded correctly on all trials during Probe III following instruction.

Table 3

Percent of Correct Responses on Observational Numerals and Number Words by Probe Conditions and Subjects

Student Condition	% Correct Responses of Numerals			% Correct Responses of Number Words		
	Pretest	Midtest	Posttest	Pretest	Midtest	Posttest
Eric						
Future	75	100	100	0	50	50
Nonfuture	100	100	100	0	0	25
Chris						
Future	50	100	100	0	0	50
Nonfuture	50	100	100	0	0	0
Scott						
Future	0	0	0	0	0	0
Nonfuture	0	0	0	0	0	0
Paul						
Future	100	100	100	0	0	100
Nonfuture	100	100	100	0	0	100
Jason						
Future	0	100	100	0	0	100
Nonfuture	0	100	100	0	0	0

Figure Captions

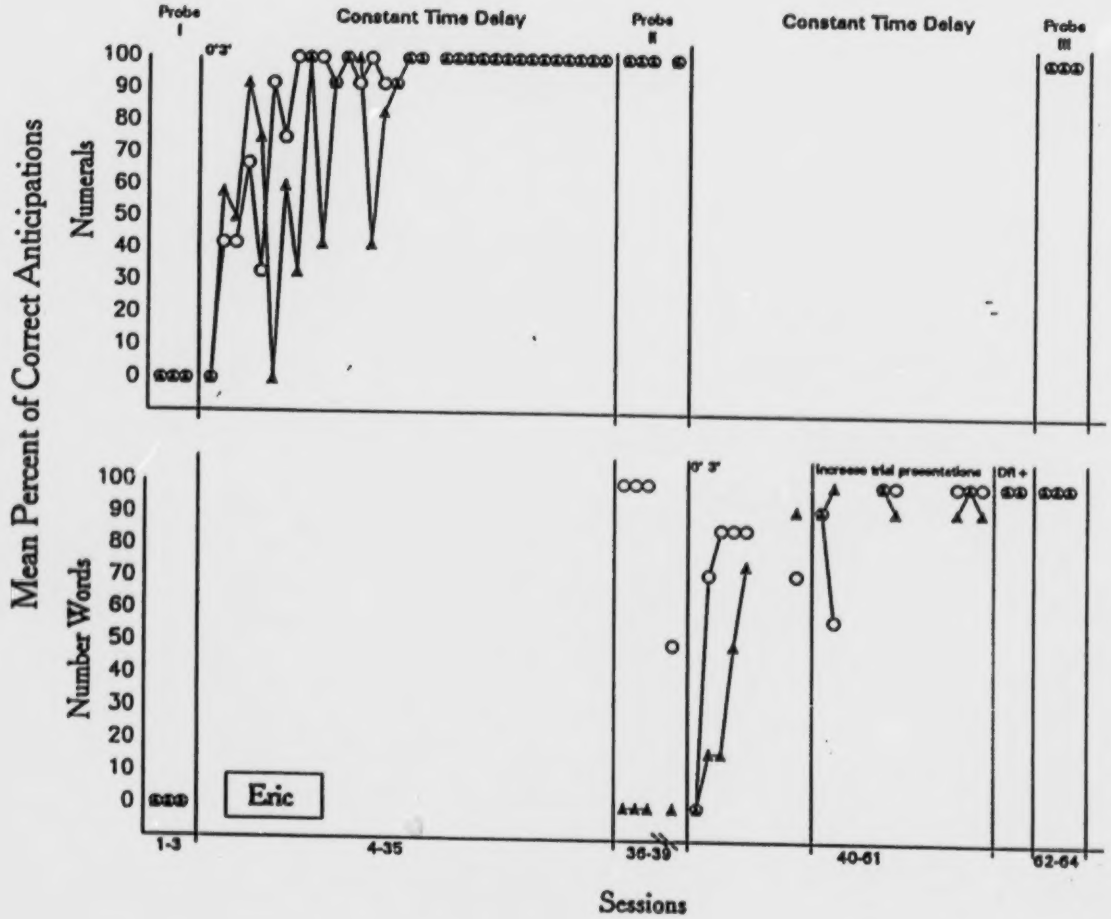
Figure 1. The percent of correct anticipations of future stimuli (open circles) and nonfuture stimuli (closed triangles) for Eric during probe and instructional conditions.

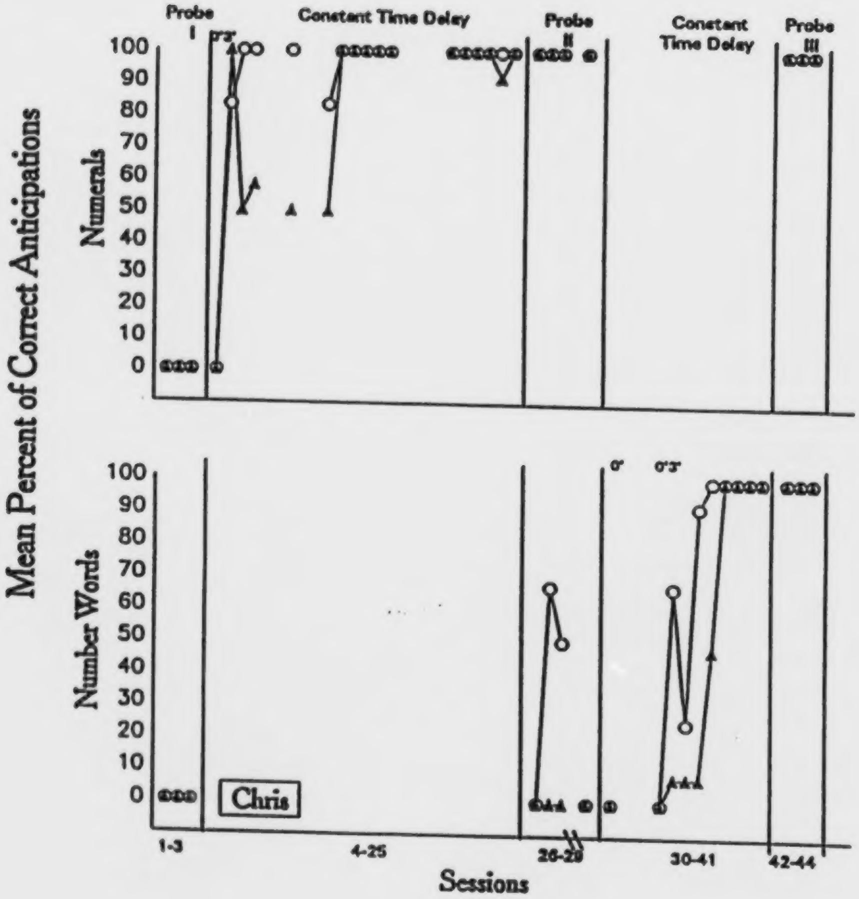
Figure 2. The percent of correct anticipations of future stimuli (open circles) and nonfuture stimuli (closed triangles) for Chris during probe and instructional conditions.

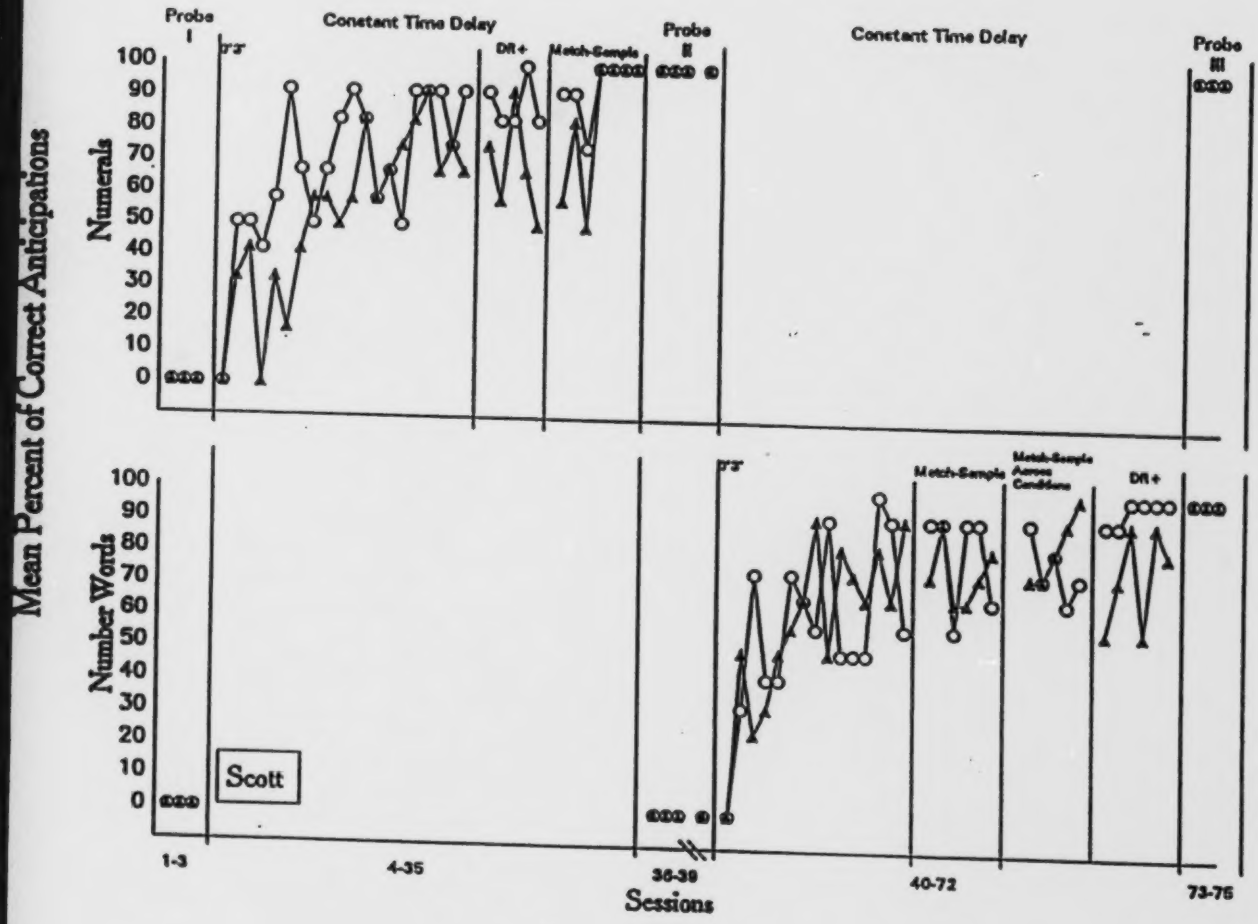
Figure 3. The percent of correct anticipations of future stimuli (open circles) and nonfuture stimuli (closed triangles) for Scott during probe and instructional conditions.

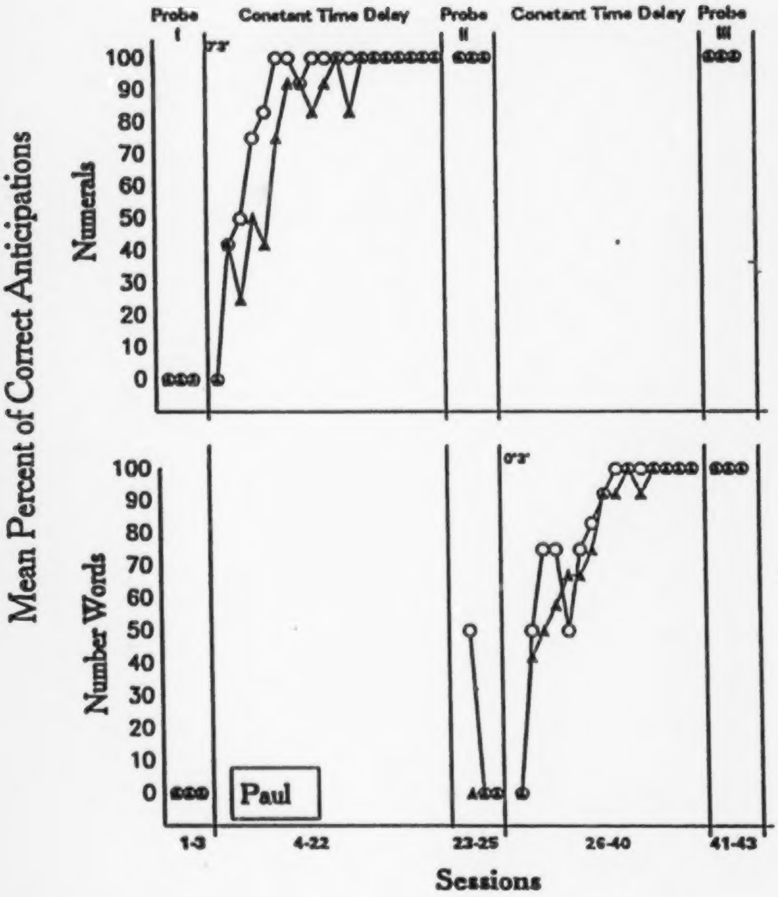
Figure 4. The percent of correct anticipations of future stimuli (open circles) and nonfuture stimuli (closed triangles) for Paul during probe and instructional conditions.

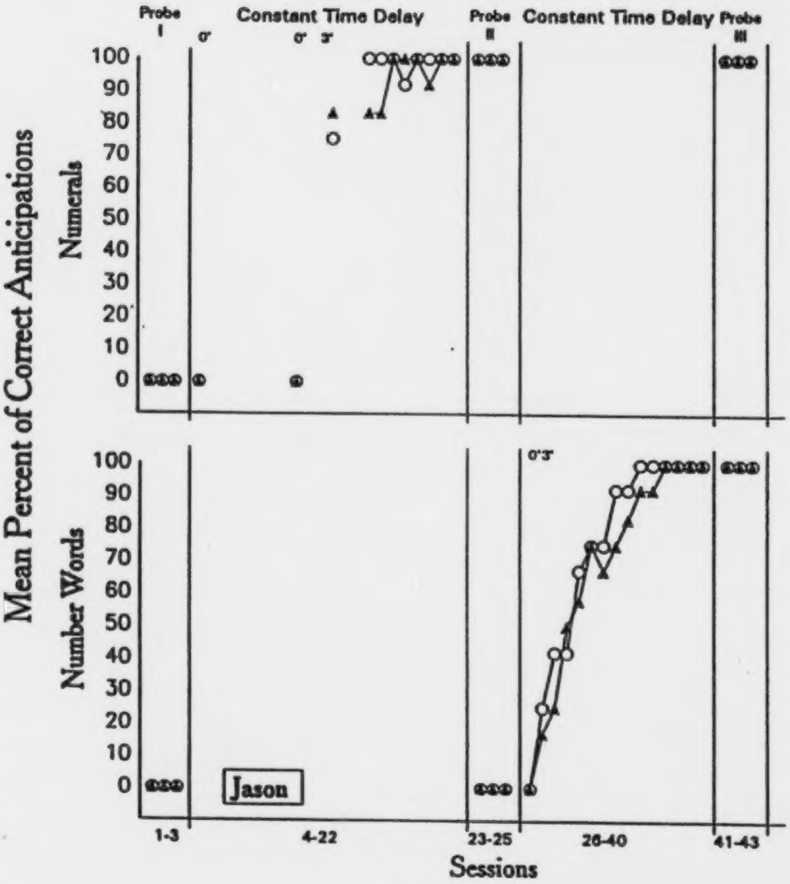
Figure 5. The percent of correct anticipations of future stimuli (open circles) and nonfuture stimuli (closed triangles) for Jason during probe and instructional conditions.


Probe I
Constant Time Delay
Probe II
Constant Time Delay
Probe III
0'3"
0' 3"
Increase trial presentations
DR +
Mean Percent of Correct Anticipations
Numerals
Number Words
100
90
80
70
60
50
40
30
20
10
0
Eric
1-3
4-35
36-39
40-61
62-64
Sessions


Probe I
Constant Time Delay
Probe II
Constant Time Delay
Probe III
0"3"
0"
0"3"
Mean Percent of Correct Anticipations
Numerals
Number Words
100
90
80
70
60
50
40
30
20
10
0
Chris
1-3
4-25
26-29
30-41
42-44
Sessions


Mean Percent of Correct Anticipations
Probe I
Constant Time Delay
0"3"
DR+
Match-Sample
Probe II
Constant Time Delay
Probe III
Numerals
100
90
80
70
60
50
40
30
20
10
0
Number Words
100
90
80
70
60
50
40
30
20
10
0
Scott
0"3"
Match-Sample
Match-Sample Across Conditions
DR+
1-3
4-35
36-39
40-72
73-75
Sessions


Probe I
Constant Time Delay
Probe II
Constant Time Delay
Probe III
0"3"
Mean Percent of Correct Anticipations
Numerals
Number Words
100
90
80
70
60
50
40
30
20
10
0
Paul
1-3
4-22
23-25
26-40
41-43
Sessions


Probe I
Constant Time Delay
0"
0" 3"
Probe II
Constant Time Delay
Probe III
Mean Percent of Correct Anticipations
Numerals
100
90
80
70
60
50
40
30
20
10
0
Number Words
0"3"
Jason
1-3
4-22
23-25
26-40
41-43
Sessions

Appendix K

Effects of Instructive Feedback on Future Learning

Effects of Instructive Feedback on Future Learning

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Abstract

This study evaluated the effects of presenting instructive feedback for current target behaviors when teaching preschoolers in dyads to name four stimulus variations: (a) the numerical value of sets of geometric figures, (b) the corresponding numeral, (c) the corresponding number word, and (d) the corresponding Roman numeral. Selected behaviors for each of the four types of stimuli were divided into two sets and instructed with a 3-second constant time delay procedure. During instruction, correct responses to one set of behaviors received a token, verbal praise, and presentation and verbal description of the future target stimuli for the currently instructed stimuli in one daily session. In the other daily session, the second set of stimuli received only tokens and verbal praise. After criterion was met on naming the numerical value of sets of geometric figures, children received instruction on naming numerals, followed by instruction on naming number words. A parallel treatments design (Gast & Wolery, 1988) was used to compare the effectiveness and efficiency of the two conditions. Results indicate that: (a) three of the four children learned all future behaviors, (b) presentation of instructive feedback did not interfere with learning, and (c) in terms of direct instruction time required by the teacher, future behaviors were acquired more efficiently.

Effects of Instructive Feedback on Future Learning

A substantial portion of the curriculum for individuals with disabilities involves teaching new forms (behaviors) to fulfill functions currently performed by less advanced behaviors (Carr, 1988). For example, teaching a child to request a drink may begin with a non-verbal signal (e.g., a point), move to one-word statements (e.g., some variant of "water"), move to two-word statements (e.g., "Want water."), and eventually move to embedding the request in various sentences (e.g., "May I have some water?" "Please give me some water" etc.). Each variation of the response fulfills the same function (i.e., a request for water). Other portions of the curriculum involve teaching children to use the same form (behavior) to respond to a variety of different stimuli or variations of those stimuli in different contexts. For example, labeling the family canine as a "dog," labeling other dogs as "dogs," labeling photographs of dogs as "dogs," and labeling pictures and line drawings of dogs as "dogs." In both cases, the curriculum is thought to be sequential; that is, some skills are taught first and then the responses are changed over time to be more complex and varied, or the responses are applied to progressively different stimulus variations.

Several strategies have been proposed for teaching students to apply the same response to different but equivalent stimulus variations. These include using multiple exemplars (Stokes & Baer, 1977), using general case programming (Albin & Horner, 1988), and systematically organizing teaching to promote and ensure generalization (Haring, 1988). Another strategy that has shown promise in teaching children to apply the same response to different stimulus formats and variations is instructive feedback (Wolery, Ault, & Doyle, 1992). Instructive feedback involves presenting additional stimuli (or various forms of the stimulus) during the consequent events for correct responses. Operationally, these trials occur as follows: The teacher secures the student's attention, presents the target stimulus and task direction, and provides a response interval. If the student responds correctly, the teacher reinforces the student and presents a second stimulus (or some stimulus variation). Students are not expected to respond to this second stimulus and are not reinforced if they do.

Studies of instructive feedback have shown that simply the presentation of additional stimuli in the consequent events will result in students acquiring some of those stimuli without direct instruction in the traditional sense (Gast, Doyle, Wolery, Ault, & Baklarz, 1991). For example, it has been used to teach students to spell sight words that they are taught to read (Gast et al., 1991), to classify stimuli on some conceptual dimension (Wolery, Holcombe, Werts, & Cipolloni, in press), to define words that they are taught to read (Shelton, Gast, Wolery, & Winterling, 1991), and to state additional factual information related to the response being taught directly (Wolery, Cybriwsky, Gast, & Boyle-Gast, 1991).

Two recent investigations have suggested that the use of instructive feedback may increase the rapidity with which skills are learned when they are later taught directly. Wolery, Doyle, et al. (1991) used progressive time delay in a one-to-one arrangement to teach elementary-aged students with moderate mental retardation to name two sets of photographs. In one set, the students were simply taught to name the photograph and the consequence for correct naming was praise. For the second set of photographs, the consequences involved praise and presentation of a written word for the object depicted in the photograph (i.e., instructive feedback). After students met criterion on both sets of photographs, the children were taught to read the words of the objects depicted in both sets. The results indicated that the use of instructive feedback (showing the written word during photograph training) resulted in more rapid learning when the students were taught to read the words directly.

In a similar study, Holcombe, Wolery, Werts, and Hrenkevich (1992) taught preschool children in a small group arrangement with constant time delay to label two sets of numerals. In one condition, the consequent events were praise and tokens. In the second condition, instructive-feedback condition, the consequent events were praise, tokens, and presentation of the number word that corresponded to the numeral being taught directly. After children met criterion on both sets of numerals, they were taught directly to read the number words that corresponded to the numerals. Again, the results indicated that the number words that had been presented through instructive feedback were learned more rapidly than those that had not been presented (i.e., they required 18% less instructional time to meet criterion).

In both of these studies (Holcombe et al., 1992; Wolery, Doyle, et al., 1991), an adapted alternating treatment design (Sindelar, Rosenberg, & Wilson, 1985) was used. This design is limited by the fact that only one opportunity existed to evaluate the effects of the instructive feedback. However, given the savings of instructional time found in these studies, the question becomes: "What effects would occur if students experienced instructive feedback on multiple sets of sequentially taught behaviors?" The current investigation was designed to answer this question. Students were measured on their ability to name four stimulus variations: (a) the numerical value of sets of geometric figures, (b) the corresponding numeral, (c) the corresponding number word, and (d) the corresponding Roman numeral. Half of each stimulus variation (e.g., half of the sets) were taught with instructive feedback (i.e., embedding the corresponding numeral in the consequent events for correct responses to number sets), and the other half was taught without instructive feedback. Further, when numerals were taught directly, instructive feedback (embedding number words in the consequent events for correct responses) was used with half of the numerals but not with the other half. Similarly, when number words were taught directly, instructive feedback (embedding Roman numerals in the consequent events for correct responses) was used with half of the number words but not with the other half. We evaluated the effects of these arrangements on the number of children who met criterion on each group of behaviors taught, and the efficiency of that instruction (i.e., number of sessions, number of minutes of instruction, and number and percent of errors to criterion).

Methods

Participants

Four preschoolers attending a half-day preschool program for children with developmental delays participated in this study. All children had no previous experience with direct instructional procedures. The four children were divided into two dyads for instruction. Children's diagnoses, chronological ages, developmental age scores, and instructional groups are presented in Table 1.

Insert Table 1 about here

To be selected as a participant in this study, children had to demonstrate the following prerequisite skills: (a) ability to attend to auditory and visual stimuli, (b) ability to wait 4 seconds for a prompt, (c) ability to sit and attend to a teacher in the presence of one other child for a minimum of 8 minutes, (d) ability to imitate a verbal model within 3 seconds of the prompt being given, and (e) ability to match to sample unknown behaviors.

Following the selection of participants based upon the prerequisite skills, behaviors were screened to identify unknown behaviors. Screening included assessment of children's ability to (a) rote count, (b) expressively identify the number of members in sets, (c) expressively identify numerals, (d) expressively identify number words, (e) expressively identify Roman numerals, (f) match to sample sets, (g) match to sample numerals, (h) match to sample number words, (i) match to sample Roman numerals, and (j) receptively identify Roman numerals. Behaviors were selected as targets when (a) receptive identification of Roman numerals was less than 25% correct; (b) expressive identification of sets, numerals, number words, and Roman numerals was 0% correct; and (c) match to sample of sets, numerals, number word, and Roman numerals was 100% correct.

Instructional Setting and Arrangements

All experimental sessions occurred in the children's classroom at a table designated for small group activities. The students sat facing a wall and the teacher sat directly across from them facing the classroom. Target probes and instructional sessions were conducted by the classroom teacher. Observational probes were conducted by a research associate. All probes were conducted in a 1:1 arrangement. Instructional sessions were conducted in dyads.

Materials and Equipment

Target stimuli were displayed on white index cards (10 mm x 15 mm) with the target behavior written in black ink on the front of the card. Stimuli in the future condition had the future targeted stimuli printed in black ink on the back of the card. Stimuli are presented by child and instructional condition in Table 1. Laminated index cards with circles drawn on them served as token cards. For each correct answer, the teacher drew an "x" in one of the circles. If each circle on the token card was filled at the end of the session, the card could be traded for the student's choice of a small tangible. A stopwatch was used to time the length of experimental sessions.

Experimental Design

A parallel treatments design (Gast & Wolery, 1988) across behaviors and replicated across subjects was employed to assess the effectiveness and the efficiency of presenting future targeted behaviors as instructive feedback during current instruction. The following sequence was used: (a) Probe I: assess all future and nonfuture target and observational behaviors, (b) Instruction Pair I: train sets in two alternating daily sessions (future and nonfuture), (c) Probe II: probe all future and nonfuture target and observational behaviors, (d) Instruction Pair II: train numerals in two alternating daily sessions (future and nonfuture), (e) Probe III: probe all future and nonfuture target and observational behaviors, (f) Instruction Pair III: train number words in two alternating daily sessions (future and nonfuture), and (g) Probe IV: probe all future and nonfuture target and observational behaviors.

Procedures

General procedures. Initially, students were screened to identify unknown sets, and corresponding numerals, number words, and Roman numerals. Four sets and corresponding numerals, number words, and Roman numerals were selected for each student. The sets were matched on stimulus characteristics, and counterbalanced across two conditions, referred to as future and nonfuture. Each student in the dyad had unique stimuli.

The future condition involved (a) direct instruction with a 3-second constant time delay procedure in naming sets and presentation of the corresponding numeral as instructive feedback for correct responses until the student demonstrated criterion level responding on sets, (b) direct instruction with a 3-second constant time delay procedure in naming the numerals (corresponding to the sets previously taught) and presentation of the corresponding number word as instructive feedback for correct responses until the student demonstrated criterion level responding on naming numerals, and (c) direct instruction with a 3-second constant time delay procedure in reading the number words (corresponding to the numerals previously taught) and presentation of the corresponding Roman numeral as instructive feedback for correct responses on the number word.

The nonfuture condition involved (a) direct instruction using a 3-second constant time delay procedure in naming sets, (b) after establishing criterion level performance, direct instruction with a 3-second constant time delay procedure in naming the corresponding numerals, and (c) after establishing criterion level performance, direct instruction with a 3-second constant time delay procedure in reading the corresponding number words. The two conditions were identical with the exception of the presentation of the future targeted behaviors during the consequent events for correct responses in the future condition (i.e., the use of instructive feedback).

Response definitions and recording procedures. The following response definitions were used during experimental conditions: (a) correct anticipations - subject correctly orally names the target stimulus within 3 seconds of the task direction (i.e., "What is this?") given by the instructor, (b)correct waits - subject verbally imitates the target stimulus within 3 seconds of the instructor's verbal model, (c) incorrect anticipations - subject says any word other that the correct word within 3 seconds of the task direction, (d) incorrect waits - subject says any word other than the correct word within 3 seconds of the instructor's verbal model, and (e) no response - subject does not respond within 3 seconds of the instructor's verbal model. During probe conditions, possible responses were correct anticipations, incorrect anticipations, and no responses. Possible responses during 0-second delay intervals were correct waits, incorrect waits, and no responses. All five responses were possible during 3-second delay intervals.

Probe procedures. In all probe sessions, the following trial sequence was used: The instructor secured the child's attention by stating, "(Child's name) look." and simultaneously holding up the stimulus card. When the child looked at the card, the teacher presented the task direction ("What is this?"), followed by a 4-second response interval. Correct responses were reinforced with verbal praise on a CRF schedule and appropriate attending to materials was reinforced with verbal praise on a VR3 schedule. Errors and no responses were ignored. A 2- to 5-second intertrial interval followed the consequent event on each trial.

The following probe schedule was used during Probe Condition I: (Day 1) two observational probe sessions, (Day 2) two target probe sessions, and (Day 3) two target probe sessions. Probe Conditions II and III followed the schedule: (Day 1) one target probe session and one observational probe session, (Day 2) one observational probe session and one target probe session, and (Day 3) one target probe session. The following schedule was implemented during Probe Condition IV: (Day 1) three target probe sessions, and (Day 2) one target probe session and two observational probe sessions.

Target probes were conducted by the instructor in a 1:1 instructional arrangement. Target probe sessions consisted of two trials per stimuli for a total of 32 trials per session. Observational probes were conducted identical to target probes, except that they were conducted by the investigator rather than the instructor.

Instructional procedures. A 3-second constant time delay procedure was used to train sets and then numerals followed by number words. One pair of behaviors was instructed with the next pair of behaviors to be trained presented as instructive feedback for correct responses (future condition). The other pair of behaviors was instructed without the presentation of instructive feedback (nonfuture condition). An individual criterion of 100% correct responses with CRF for two days and 100% correct responses with VR3 for two days was employed in each instructional condition.

Instructional sessions consisted of 8 trials per stimuli for each student and 32 trials per session. A 0-second delay interval was utilized during the first two instructional sessions. All subsequent sessions used a 3-second delay interval. The following trial sequence was used for 0-second nonfuture instructional sessions: The teacher secured the child's attention by stating, "(Child's name), look." and simultaneously holding up the stimulus card. After the child looked at the card, the teacher stated the task direction, "What is this?", and immediately presented the controlling prompt (verbal model). After presenting the controlling prompt, a 3-second response interval was provided followed by the appropriate consequent event and a 2- to 5-second intertrial interval. Correct responses were followed by verbal praise and an "x" on the token card. Incorrect responses and no responses were ignored. In the future instructional sessions, the trial sequence was identical with the exception of the consequent event for correct responses. In addition to verbal praise and an "x" on the token card, the stimulus to be taught in the next set of behaviors with the same response was shown to the child simultaneous to the teacher stating, "You're correct, and this is another (response)." For example, during instruction on numerals, when the student correctly named the numeral "9" the instructor placed an "x" on the token card, turned the stimulus card over to show the number word "nine" and stated, "That's right, and this is another nine."

All sessions following the 0-second delay interval sessions employed a 3-second delay interval. The following trial sequence was used during 3-second instructional sessions: The teacher secured the child's attention by stating, "(Child's name), look." and simultaneously holding up the stimulus card. After the child looked at the card, the teacher stated the task direction, "What is this?", and then provided a 3-second response interval before presenting the controlling prompt. After presenting the controlling prompt, another 3-second response interval was provided followed by the appropriate consequent event and a 2- to 5-second intertrial interval. In the nonfuture instructional sessions, correct responses both before and after the prompt were followed by verbal praise and an "x" on the token card. Incorrect responses and no responses both before and after the prompt were ignored. In the future instructional sessions the trial sequence was identical with the exception of the consequent event for correct responses. In addition to verbal praise and an "x" on the token card, the stimulus to be taught in the next tier with the same response was shown to the child simultaneous to the teacher stating "You're correct, and this another (response)."

Reliability

Dependent measure reliability data were collected by a research associate at least once in each experimental condition and once a week in conditions lasting longer than one week. A point-by-point method of scoring inter-observer agreement was used (number of exact agreements divided by the number of agreements plus disagreements multiplied by 100) to calculate inter-observer agreement percentages. Data were collected on the following teacher behaviors: presenting an attentional cue; ensuring the child's attention was secured; presenting the task direction; waiting the appropriate delay interval; presenting the controlling prompt; providing the appropriate consequent event; and waiting the intertrial interval. Procedural reliability data were also collected and calculated by dividing the number of actual teacher behaviors by the number of planned teacher behaviors and multiplying by 100 (Billingsley, White, & Munson, 1980).

Results

Inter-observer Agreement and Procedural Fidelity

Dependent measure reliability. Inter-observer agreement data were collected in 27% of the probe sessions for each student, 24% of the future sessions and 27% of the nonfuture sessions for Brian, 21% of both the future and nonfuture sessions for Rebecca, 22% of both the future and nonfuture sessions for Jared, and 20% of the future sessions and 22% of the nonfuture sessions for Kattie. The percent of agreement in each experimental session for each student was 100.

Procedural reliability. Procedural reliability data were collected in 27% of the probe sessions for each student. During instructional sessions, procedural reliability data were collected during 24% of the future sessions and 27% of the nonfuture sessions for Brian, 21% of both the future and nonfuture sessions for Rebecca, 22% of both the future and nonfuture sessions for Jared, and 20% of the future sessions and 22% of the nonfuture sessions for Kattie.

Procedural reliability during all probe sessions for each teacher behavior for all students was 100%. Procedural reliability during instructional sessions for each teacher behavior was 100% with the following exceptions: (a) for the future condition, the percent of correct implementation for presenting the attending cue for Kattie was 99.4 (97-100), for waiting the appropriate delay interval for Kattie was 99.4 (94-100), and for providing the appropriate consequence for Rebecca and Kattie was 94.8 (97-100) and 99.4 (95-100) respectively; and (b) for the nonfuture condition, the percent of correct implementation for presenting the attending cue for Jared was 98.4 (88-100), for securing attention for Jared was 98.9 (88-100), for providing the task direction for Kattie was 99.6 (94-100), and for providing the appropriate consequence for Brian and Kattie was 98.2 (95-100) and 99.6 (94-100), respectively. Across all trials where an error occurred in providing the appropriate consequence, the error was a result of the instructor failing to mark an "x" on the token card.

Effectiveness

The percent of correct responding for all experimental conditions are shown in Figures 1, 2, 3, and 4. All students exhibited 0% correct responding in Probe I. The introduction of constant time delay in both conditions (future and nonfuture) for identifying the number of members in a set resulted in Brian, Rebecca, and Kattie achieving criterion level responding. No procedural modifications were needed for Brian. Two procedural modifications were made with Rebecca. On the ninth instructional session, a match-to-sample specific attending cue was added. The two behaviors for the condition receiving instruction were placed on the table in front of Rebecca. The instructor then showed Rebecca another behavior and asked, "Which one is the same?" This manipulation did not result in a substantial increase in correct anticipations, therefor a second modification was introduced. During this modification, the target stimulus was placed on the table in front of Rebecca. Rebecca was given red chips and told to cover each dot on the stimulus card with a chip. This manipulation resulted in 100% correct anticipations in both conditions (future and nonfuture). After the first session with 100% correct anticipations, the specific attending cue was dropped to ensure that Rebecca was naming the number of members in the target set rather than counting the chips. Two procedural modifications were required for Kattie. A match-to-sample specific attending cue was introduced on the tenth day of instruction. This procedural implementation was identical to that described for Rebecca. Because Kattie was anticipating correctly on the first trial presentation in the future conditions, differential reinforcement was introduced in both conditions. Correct anticipations received verbal praise and an "x" on the token card, and correct waits received verbal praise. Following this modification, criterion was met in both conditions.

Insert Figures 1, 2, 3, and 4 about here

In the Probe II condition, correct performance for sets was 100% for Brian, Kattie, and Rebecca in both the future and nonfuture conditions. Correct responding in Probe II condition was 100% for both numerals for Brian, 100% for one numeral and 50% for the other numeral for Rebecca, and 100% for one numeral for Kattie. Each of these occurred on the instructive feedback stimuli

Following Probe II, constant time delay was implemented with numerals in two conditions (future and nonfuture). Brian received one review trial for each numeral in the future condition. Criterion was met in the nonfuture condition without any procedural modifications. In the future condition, both Rebecca and Kattie received one review trial for one target behavior and all eight trials for the other target behavior. Both students achieved criterion level performance with modification of instructional procedures.

During Probe III, Brian had 100% correct responding across three probe sessions to one of the two number words presented as instructive feedback. Rebecca had 100% correct responding to one of the two number words presented as instructive feedback during the first probe session, however, she had 0% correct responding in the next two probe sessions. Kattie did not respond correctly to either of the number words presented as instructive feedback.

Students received direct instruction on number words following Probe III. In the future condition, Brian received one review trial for one behavior and all eight trials for the other behavior. He achieved criterion in both conditions without any procedural modifications. Modifications of the instructional procedures were not implemented with Rebecca or Kattie; however, instruction was stopped due to the end of the school year. During Probe IV, Brian responded at 100% correct to all previously taught behaviors. In addition, the percent of correct responding to one of the Roman numerals presented as instructive feedback was 100 across all probe sessions. Rebecca responded at 100% correct to all stimuli previously instructed in the future condition. However, in the nonfuture condition, Rebecca did not have consistent 100% correct responding. Although Rebecca did not have 100% correct responding to either of the Roman numerals presented as instructive feedback, she did respond correctly to some presentations of one of those Roman numerals. In Probe IV, Kattie responded correctly to all previously instructed stimuli in the future condition and a majority of those in the nonfuture condition. She did not respond correctly to any of the future or nonfuture Roman numerals.

Efficiency

As noted previously, one of the primary objectives of this study was to evaluate the effects of instructive feedback on the efficiency of learning. In Table 2, data are presented on the number of trials, number of errors, and percent of errors through all instructional sessions for each behavior pair for both the future and nonfuture conditions.

Insert Table 2 about here

During instruction on sets, differences in the number of trials through criterion were equivalent for Brian, Rebecca, and Kattie with the future condition requiring twelve trials more than the nonfuture condition. Differences in the number and percent of errors across the two conditions (future and nonfuture) were slight for Brian, Rebecca, and Kattie.

Difference between the future and nonfuture condition during numeral instruction result in the future condition requiring 84 fewer trials for Brian, 31 fewer trials for Rebecca, and 176 fewer trials for Kattie than the nonfuture condition. Differences in the number and percent of errors are not as great for Brian and Rebecca. Brian had no errors in both conditions and Rebecca had no in the future condition and only 2 errors in the nonfuture condition. However, Kattie had 1.1% errors in the future condition and 7.3% errors in the nonfuture condition.

Brian was the only student who met criterion in both conditions during number word instruction. Rebecca did not meet criterion in the nonfuture condition; however, she did respond correctly to these stimuli during the final probe. Therefore, her data are presented and discussed in terms of efficiency. In terms of trials through criterion, less trials were required in the future condition for both Brian and Rebecca, 77 and 12 respectively. Differences in terms of the number and percent of errors through criterion result in the future condition requiring slightly fewer errors for both Brian and Rebecca. Kattie did not reach criterion in the nonfuture condition and did not respond correctly with consistency across the nonfuture stimuli in the final probe. However, it can be noted that the future condition met criterion, while the nonfuture condition did not. Also, the future condition had 20 errors (6.9%) and the nonfuture condition had 25 errors (8.9%).

In terms of teacher time required to instruct behaviors, Dyad A (Brian and Rebecca) received 395 minutes and 42 seconds of direct instruction and acquired 14 behaviors during the future condition. This results in a mean of 28 minutes and 15 seconds of teacher time necessary to teach each behavior. The nonfuture condition received 374 minutes and 25 seconds of direct instruction with 10 behaviors acquired with a mean of 37 minutes and 27 seconds of direct instruction per behavior. For Group A, the instruction through criterion of future condition behaviors required only 76% of the direct instruction time required for the nonfuture condition behaviors.

For Dyad B (Jared and Kattie), the future condition received 220 minutes and 47 seconds of direct instruction and acquired 8 behaviors. In contrast, the nonfuture condition received 258 minutes and 36 seconds of direct instruction and acquired only 4 behaviors. Therefore, the future condition required a mean of 27 minutes and 35 seconds for each behavior and the nonfuture condition required a mean of 64 minutes and 39 seconds for each behavior. For Group B, the instruction through criterion of future condition behaviors required only 42% of the direct instruction time required for the nonfuture condition behaviors.

Observational Learning

During each probe condition, students were assessed on expressive naming of the other dyad members' target and instructive feedback behaviors. Observational sets, numerals, number words and Roman numerals were assessed in two probe sessions during each of the four Probe conditions. Because students moved at an individual pace, students did not have opportunities to observe their peers receiving instruction on all behaviors. Brian saw Rebecca being instructed on sets and numerals and the number words presented as instructive feedback (i.e. number words from the future condition). During Probe I, Brian responded correctly to one of the sets of geometric figures from the future condition. In Probe II, he had acquired (i.e., 100% correct responding to all trial presentations of a behavior) all the sets which were instructed to his peer and all the future numerals presented as instructive feedback. His Probe III performance was identical to his performance in Probe II. In Probe IV, he maintained his performance in Probe III and acquired both nonfuture numerals taught to his peer.

Rebecca saw Brian being instructed on all behaviors in both the future and nonfuture conditions. During Probe I, Rebecca did not respond correctly to any of her peer's target behaviors. In Probe II, Probe III, and Probe IV she acquired and maintained acquisition level performance for all numerals from both the future and nonfuture conditions. The percent of correct responding to all other behaviors remained at O.

Kattie saw Jared receiving instruction on naming number of members in sets of geometric figures, and the presentation of numerals from the future condition. In Probe I, her percent of correct responding to all observational behaviors was 0. In Probe II, she acquired one each of the future and nonfuture sets of geometric figures. In addition, she acquired both of the numerals which she observed being shown to her peer as instructive feedback. The percent of correct responding to all other behaviors was 0. Performance in Probe III and Probe IV was identical to that of Probe II.

Results for Jared

Jared received instruction only on naming the number of members in sets of geometric figures. In Probe I he had 0% correct responding to all target behaviors across all conditions. He met criterion in the future condition and then received review trials; however, he did not meet criterion in the nonfuture condition. Several modifications of procedure were introduced in the nonfuture condition: (a) match-to-sample; (b) differential reinforcement; (c) increase in back-up reinforcer; and (d) an additional instructional session each day. In addition to these planned procedural modifications, several other "modifications" were introduced. Following the eighteenth day of instruction, Jared was absent for one week. Upon his return, it was decided by his intervention team that he would attend the preschool on only Monday, Wednesday, and Friday morning.

In terms of efficiency, we can report the number of trials, number of errors, and percent of errors for the sessions in which he received instruction. These measures are presented in Table 2. We cannot compare the efficiency of the two procedures "accurately" because the study was terminated due to the end of the school year before criterion was reached in the nonfuture condition.

Jared observed his peer being instructed on all her target behaviors. In Probe I, he had 0% correct responding to all observational behaviors. During Probe II, he exhibited 100% correct responding to all numerals from both the future and nonfuture conditions. Correct responding to all other behaviors was 0%.

Discussion

This study assessed the effects of presenting instructive feedback for current target behaviors when teaching children four stimulus variations. Based on the results, several findings are discussed. First, the presentation of instructive feedback in the future condition did not interfere with acquisition of target behaviors. This is similar to findings of previous research (Holcombe et al., 1992; Wolery, Doyle, et al., 1991). With naming numerals and naming number words, the future condition required fewer trials and percent of errors than the nonfuture condition.

Second, constant time delay resulted in three of the four students learning to name the numerical value of sets of geometric figures, the corresponding numeral, and the corresponding number word. For the fourth student, Jared, the procedure was effective in the acquisition of naming the numerical value of sets of geometric figures in the future condition. Jared exhibited noncompliant and inappropriate behaviors throughout training which interfered with instruction. He was removed from four instructional sessions as a result of tantrums. As stated earlier, several procedural modifications were made, none of which were successful in Jared's achieving criterion level performance. He continued to respond inconsistently to the nonfuture behaviors in spite of the modifications.

Third, teacher direct instruction time required was greater for the nonfuture condition. Nonfuture instruction resulted in 21 additional minutes and the acquisition of 4 less behaviors for Group A, and 38 additional minutes and the acquisition of 4 less behaviors in Group B. For Group A, four future behaviors were taught in approximately the same amount of time as three nonfuture behaviors. For Group B, seven future behaviors were taught in approximately the same amount of time required of three nonfuture behaviors. Thus, the future condition resulted in more behaviors being learned in less instructional time. When the number of behaviors acquired across all subjects are summed and divided by the total number of minutes of instruction per condition, the future condition resulted in a mean of 28 minutes of instruction per behavior, and the nonfuture condition resulted in 47 minutes of instruction per behavior. Therefore, the future condition required about 59.6% of the time required of the nonfuture condition to establish criterion on a single behavior. Thus, for every 10 hours of instruction, one would expect 21 behaviors to be acquired in the future condition, and nearly 13 behaviors to be acquired in the non-future condition. These data seem to suggest that there are substantial savings of instructional time by using instructive feedback for behaviors and subjects similar to those taught in this investigation.

Fourth, the addition of the instructive feedback in the consequent event resulted in more rapid acquisition (trials through criterion) of those behaviors when they were subsequently instructed. Future behaviors required 77% of the trials required of nonfuture behaviors.

In furthering this line of research, three issues are worthy of discussion. First, similar research should be conducted with different populations and varying tasks. The effects of instructive feedback on future instruction has been investigated with elementary students when naming photographs and the and naming the corresponding word for the object depicted in the photograph (Wolery, Doyle, et al., 1991); preschool students when naming numerals and the corresponding number words (Holcombe et al., 1992); and preschool students when naming the numerical value of sets of geometric figures, and the corresponding numerals, number words, and Roman numerals. The effects of this research should by investigated across a larger variety of students and skills.

Second, previous research (Holcombe et al., 1992; Wolery, Doyle, et al., 1991) in this area as well as the present study have presented in instructive feedback information in a static format. The instructive feedback information was presented in black ink on white index cards across all trials. In addition, Holcombe et al. (1992) and this study presented the instructive feedback in the same format as the target information. It remains to be investigated whether varying the presentation of the instructive feedback from that of the target behaviors, or varying the presentation of the instructive feedback across trials would result in greater acquisition of those behaviors by the target student or his peers. Also, varying schedules of presenting the instructive feedback should be evaluated. In this study, the instructive feedback was presented on each trial in which the student gave a correct response. An intermittent schedule of instructive feedback presentation may result in differential acquisition rates of that information as compared to a continuous schedule of instructive feedback presentation.

Finally, in these studies the "future" target stimuli presented through instructive feedback were related to the target behavior (i.e. required the same response). Research should evaluate whether instructive feedback will increase the rapidity of future learning when that feedback has a different response from the target behavior. For example, during instruction on word reading, instructive feedback would provide the sequence of the letters in the target word. Such a study would allow for instruction on two different responses (i.e., the word name and the spelling of the word).

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Table 1

Student Demographics and Target Behaviors by Instructional Condition

Dyad Child	CA[a]	Disability	Developmental Ages							Target Behavior[d]	
			SC[b]	AD[b]	MT[b]	CM[b]	CG[b]	EL[c]	RL[c]	Future	Nonfuture
Dyad I											
Brian	60	Developmental/ Language Delay	44	44	54	34	51	39	54	6,10	4,8
Rebecca	44	Seizure Disorder/ Developmental Delay	27	24	28	30	26	30	30	3,7	5,9
Dyad II											
Jared	57	Attention Deficit Disorder/ Developmental Delay	51	41	52	44	51	41	45	4,8	6,10
Kattie	58	Developmental/ Language Delay	50	37	38	47	41	41	46	5,9	3,7

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[a] CA = Chronological Age.

[b] Developmental Age scores in these domains derived from the *Batelle Developmental Inventory* (Newborg, Stock, Wneck, Guidubaldi, & Svinicki, 1984). SC = Social, AD = Adaptive, MT = Motor, CM = Communication, CG = Cognitive.

[c] Developmental Age scores in these domains derived from the *Preschool Language Scale* (Zimmerman, Steiner, & Pond, 1979). RL = Receptive Language, EL = Expressive Language.

[d] The stimuli for the study were sets of geometric shapes, corresponding numerals, corresponding number words and corresponding Roman numerals.

Table 2

Number of Trials, Number of Errors and Percent of Errors by Student and Condition

Student Behaviors	Number of trials		Number of errors		Percent of errors	
Condition[a]:	F	NF	F	NF	F	NF
Brian						
Sets	384	372	4	1	1.0	0.3
Numerals	12	96	0	0	0.0	0.0
Words	99	176	5	7	5.1	4.0
Total	495	644	9	8	1.8	1.2
Rebecca						
Sets	768	756	51	48	6.6	6.3
Numerals	117	148	0	2	0.0	1.4
Words	116	128	2	4	1.7	3.1
Total	1,001	1,032	53	54	5.3	5.2
Jared						
Sets	401	875	16	105	4.0	12.0
Kattie						
Sets	368	356	11	7	3.0	2.0
Numerals	192	368	2	27	1.1	7.3
Words	288	288	20	25	6.9	8.9
Total	848	1,012	33	59	3.9	5.8
Grand Total	2,745	3,563	111	226	4.0	6.3

[a] F = Future condition, NF = Nonfuture condition.

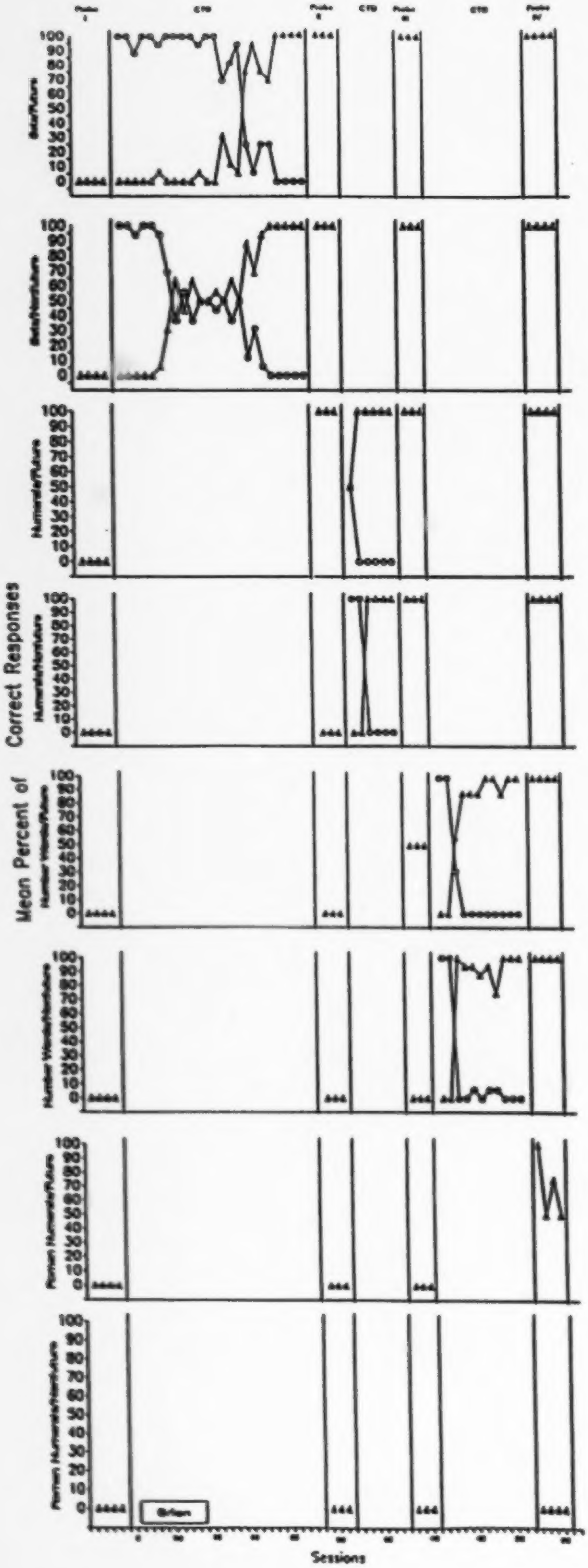
Figure Captions

Figure 1. The percent of correct unprompted responses (closed triangles) and the percent of correct prompted responses (open circles) by Brian during probe and instructional conditions.

Figure 2. The percent of correct unprompted responses (closed triangles) and the percent of correct prompted responses (open circles) by Rebecca during probe and instructional conditions.

Figure 3. The percent of correct unprompted responses (closed triangles) and the percent of correct prompted responses (open circles) by Jared during probe and instructional conditions.

Figure 4. The percent of correct unprompted responses (closed triangles) and the percent of correct prompted responses (open circles) by Kattie during probe and instructional conditions.



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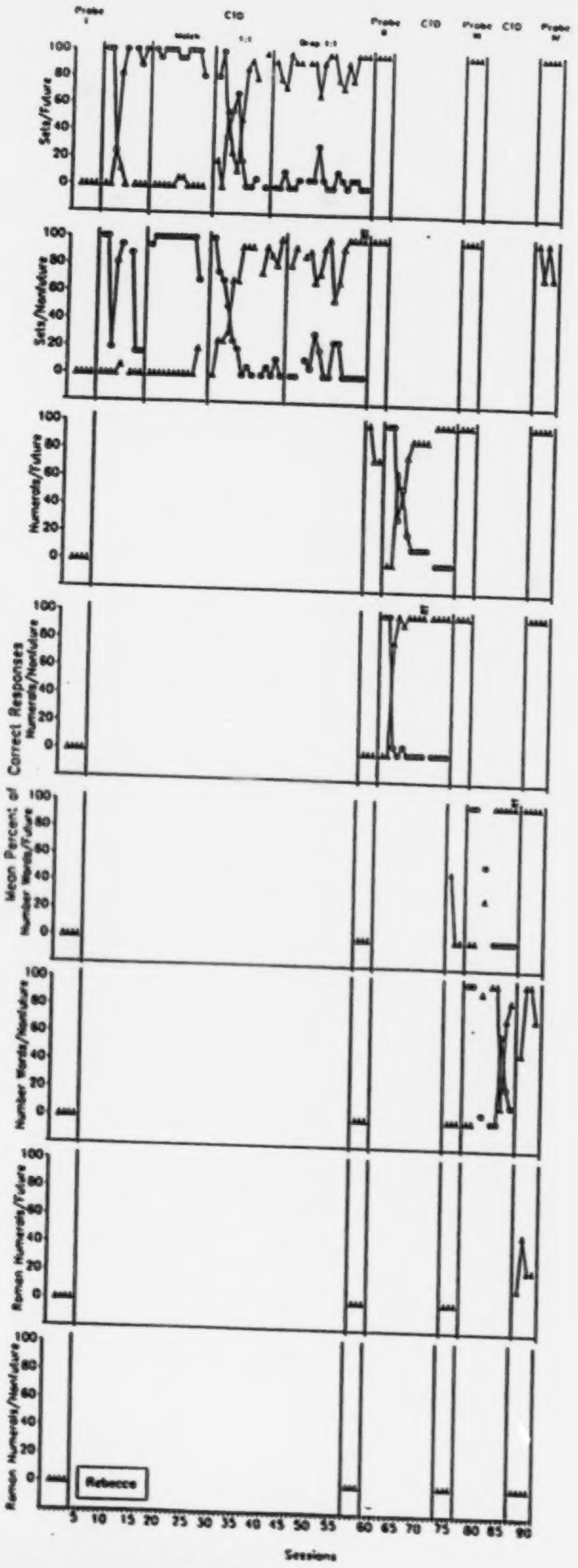

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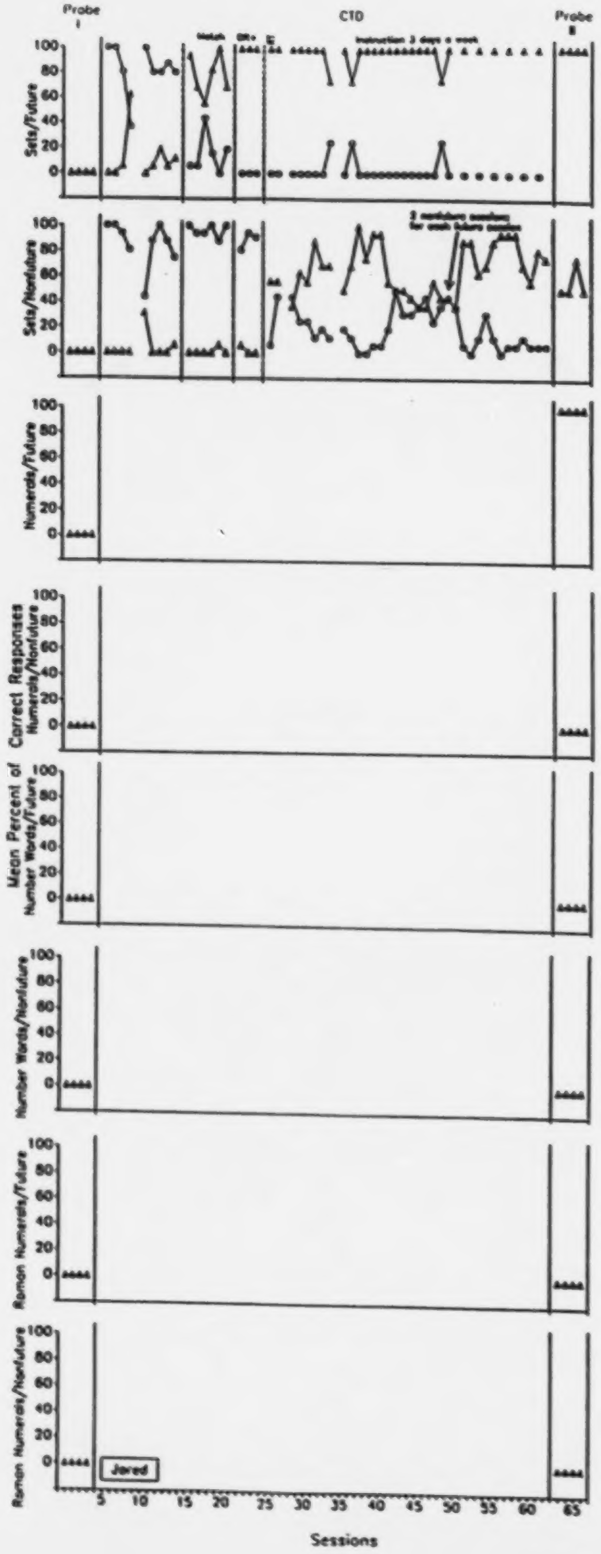
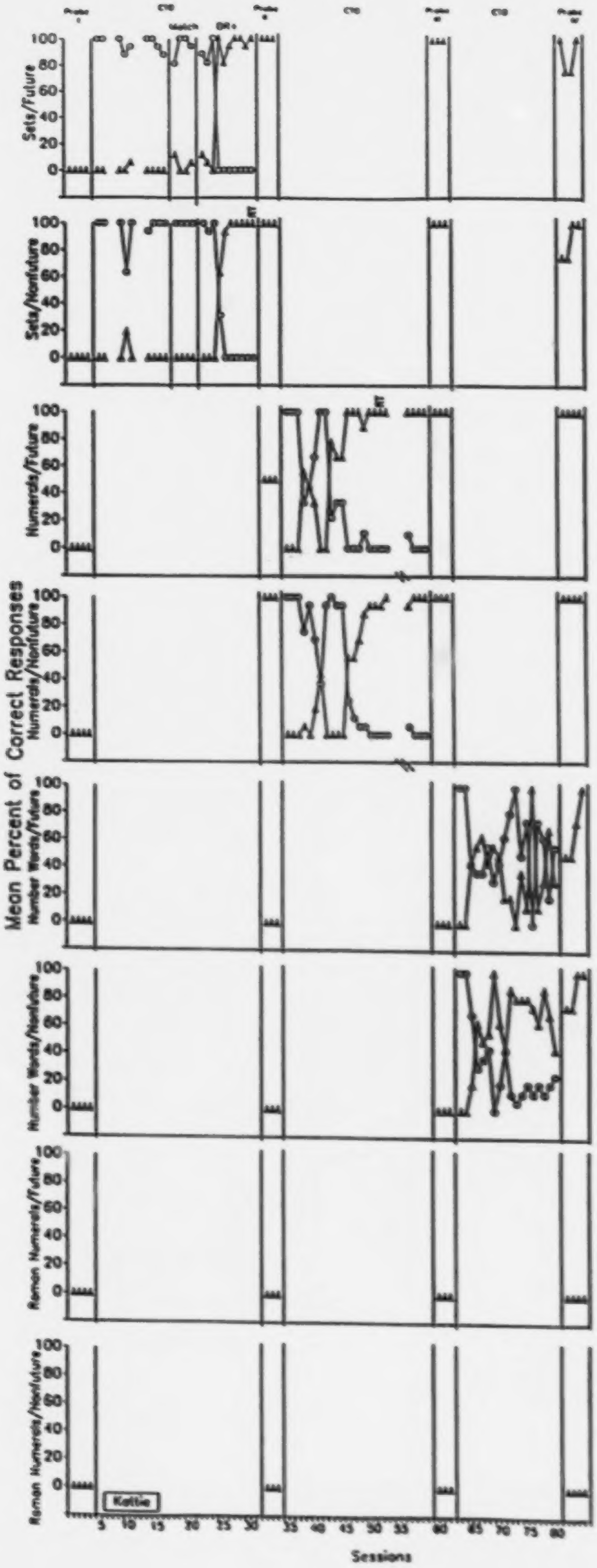

Probe
I
CTD
Probe
II
Match
Dif+
E
Instruction 3 days a week
2 nonfuture sessions for each future session
Sets/Future
Sets/Nonfuture
Numerals/Future
Numerals/Nonfuture
Number Words/Future
Number Words/Nonfuture
Roman Numerals/Future
Roman Numerals/Nonfuture
Mean Percent of Correct Responses
100
80
60
40
20
0
Jared
5
10
15
20
25
30
35
40
45
50
55
60
65
Sessions


Probe
I
CTD
Match
DR+
Probe
II
CTD
Probe
III
CTD
Probe
IV
E
Mean Percent of Correct Responses
Sets/Future
Sets/Nonfuture
Numerals/Future
Numerals/Nonfuture
Number Words/Future
Number Words/Nonfuture
Roman Numerals/Future
Roman Numerals/Nonfuture
0
20
40
60
80
100
Kattie
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
Sessions

Appendix L

Effects of Instructive Feedback Related and Unrelated To the Target Behavior

Effects of Instructive Feedback Related and Unrelated to the Target Behaviors

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Abstract

Two studies were implemented to compare the acquisition of stimuli that was related and unrelated to the target stimuli being taught. A constant time delay procedure with instructive feedback was used. Five students, ages 9 and 10 years and enrolled in a class for students needing emotional support, were participants. The teacher used a massed trial format to teach two conditions on alternating days, one with related and one with unrelated instructive feedback. The results of the first experiment, indicated that (a) all children learned the target behaviors, and (b) all students learned more of the unrelated instructive feedback stimuli. In the second experiment the procedures were repeated, reversing the academic domains of the related and unrelated stimuli. The results indicated that (a) all students learned the target behavior, and (b) 4 of the 5 students learned an equal amount or more of the related instructive feedback stimuli. The implications of considering novelty, interest, and difficulty of instructive feedback stimuli are discussed.

Effects of Instructive Feedback
Related and Unrelated to the Target Behaviors

To increase the number of behaviors learned during direct instruction and to diversify instructional sessions, investigators have presented additional stimuli to students during the consequent events for correct responses. This procedure has been called "instructive feedback" (Wolery, Ault, & Doyle, 1992), and trials occur as follows: The teacher secures the student's attention, presents the target stimulus and task direction, and provides a response interval. If the student responds correctly, the teacher reinforces the student and presents a second stimulus. Students are not expected to respond to this second stimulus and are not reinforced if they do; the stimulus is simply presented.

Studies of instructive feedback produced a number of findings. First, when instructive feedback is used, students acquire some, and in other cases all, of the extra information presented in consequent events (Gast, Doyle, Wolery, Ault, & Baklarz, 1991). Second, the acquisition of instructive feedback stimuli occurs for (a) preschoolers with developmental delays (Wolery, Holcombe, Werts, and Cipolloni, in press) and hearing impairments (Wolery, Werts, Holcombe, Billings, & Vassilaros, in press); (b) elementary-aged students with learning disabilities (Harrell, Wolery, Ault, DeMers, & Smith, 1991), mild mental retardation (Shelton, Gast, Wolery, & Winterling, 1991), and moderate mental retardation (Gast, Wolery, Morris, Doyle, & Meyer, 1990); and (c) secondary students with learning and behavioral disorders (Wolery, Cybriwsky, Gast, and Boyle-Gast, 1991) and moderate mental retardation (Doyle, Gast, Wolery, Ault, & Farmer, 1990). Third, the acquisition of extra information presented through instructive feedback has been documented in one-to-one instruction (Wolery, Doyle, Ault, Gast, Meyer, & Stinson, 1991) and small group instruction (Gast et al., 1991) Fourth, students can acquire two pieces of extra information for each behavior taught directly when both pieces of information are presented on every trial (Gast, Doyle, Wolery, Ault, & Baklarz, 1992) or on alternating trials (Wolery, Werts, et al., in press). Fifth, presentation of future target behaviors through instructive feedback results in more rapid subsequent learning of those behaviors (Holcombe, Wolery, Werts, & Hrenkevich, 1992; Wolery, Doyle, et al., 1991). Sixth, the use of specific attention responses (i.e., having students repeat the task direction before answering) results in more observational learning of the stimuli presented during peers' instructive feedback than does the use of general attentional responses (i.e., looking at the teacher during presentation of the task question) (Wolery, Cybriwsky, et al., 1991). Seventh, the use of instructive feedback does not appear to influence the rapidity with which target behaviors are acquired (Gast et al., 1991; Wolery, Doyle, et al., 1991) or increase the length of instructional sessions (Holcombe et al., 1992).

However, much remains to be learned about the conditions under which students acquire instructive feedback stimuli. In one study (Gast et al., 1992), students were taught to label pictures of buildings in the local community. Through instructive feedback, they were told two types of information: (a) the name of the street on which the building was located, and (b) the activity that occurred in that building. When students were taught to label the building and told only the street name, they learned to label the building and name the street where it was located. In conditions where they were taught to label the building and told both the street name and activity, they learned to label the building and identify the activity that occurred in the building; they did not, however, learn to name the street. When students were taught to label the building and told two activities that occurred in each building, they learned to label the building and name both activities. Two explanations were proposed for these findings. Labeling the activities that occurred in each building was acquired more readily than naming the street on which the building was located because (a) naming the activity was easier than naming the street, and/or (b) naming the activity was more related to the building name or more relevant to students' experiences than was the street name.

As a result, we conducted two investigations to evaluate the conditions under which instructive feedback stimuli were acquired. In both studies, it was questioned whether students would acquire more stimuli presented through instructive feedback if those stimuli were related (from the same academic domain) to the target behaviors (i.e., those being taught directly) as compared to unrelated (from a different academic domain). In the first study, students were taught to label a fraction that was shown pictorially and were presented through instructive feedback with either the equivalent percentage (i.e., related instructive feedback stimuli) or an outline of a state from the United States (i.e., unrelated instructive feedback stimuli).

Experiment I

Methods

Subjects

Five students (2 girls and 3 boys), from a classroom for emotional support, housed in a suburban public elementary school district, were selected for participation in the study. They ranged in age from 9 years 3 months to 10 years 7 months and were enrolled in the third, fourth, and fifth grades. All were caucasian, from middle income, single parent homes, and all were integrated into regular education classes for part of their school day.

Tyler, a 9-year-6-month male, was enrolled in third grade and had received special educational services since kindergarten. His diagnosis was listed as Adjustment Disorder with Attention Deficit Disorder-Hyperactive. A Stanford-Binet Intelligence Test (Thorndike, Hagen, & Sattler, 1986), given by a psychologist from an outside agency, yielded a full scale IQ of 78, a verbal score of 86, abstract visual score of 84, quantitative score of 92 and short term memory score of 66. On the Revised Developmental Test of Visual-Motor Integration (Beery, 1982), he scored in the 65th percentile.

Linda, a 10-year-7-month old female, had received special education services for five years and was enrolled in the fifth grade. She was diagnosed as Socially and Emotionally Disturbed with a mild seizure disorder. On the Wechsler Intelligence Scale for Children-Revised (WISC-R) (Wechsler, 1974), given by the school's psychologist, she received a verbal score of 111, a performance score of 112, and a full scale score of 112.

Chad, a 9-year-3-month old male, was enrolled in third grade and had received special education services since first grade. He was diagnosed as Socially and Emotionally Disturbed with a Mixed Specific Developmental Delay. On a WISC-R, given by an outside agency, he received a verbal score of 109 and a performance score of 104, yielding a full scale score of 107. He evidenced weak phonological skills with a language quotient on the Test of Language Development-2 (Newcomer & Hammill, 1988) of 83.

Courtney, a 10-year-2 month old female, was enrolled in fourth grade and had received special education services for two years. She was diagnosed as Socially and Emotionally Disturbed. On the WISC-R given by the school psychologist, she received a verbal score of 88, a performance score of 78, and a full scale score of 82. On the Visual-Motor Gestalt Test (Bender, 1938), she received a standard score of 76, showing significant motor delays.

Alex, a 10-year-0-month old male, was enrolled in fourth grade having been placed in special education programming two years earlier. He was diagnosed as having a Schizoid Disorder, Childhood Antisocial Behavior, Expressive Language Delay, Possible Mixed Specific Developmental Delays, and a visual acuity deficit. On a WISC-R given by an outside agency, he scored a verbal score of 107, a performance score of 128, yielding a full scale score of 118. He was taking Ritalin daily during the study.

Setting

The classroom, a self-contained with integration model, was housed in a elementary school (kindergarten through fifth grade) in a suburban school district. Eight children were enrolled and the class was staffed by a full time teacher and a 1/2 time teaching assistant. Experimental sessions were conducted by the teacher and occurred in the classroom (5.5 m x 8.5 m) at a semi-circular table at the front of the classroom. The students sat facing the teacher. The sessions occurred at the beginning of the school day. The two conditions were alternated with one being presented every other day beginning with the related instructive feedback condition. Probe sessions, also conducted by the teacher, occurred individually, prior to implementing instruction and after criterion was reached.

Materials

Three sets of instructional materials were used during instruction: (a) target stimuli, (b) related non-target stimuli, and (c) unrelated non-target stimuli. Non-target stimuli were those presented through instructive feedback. For all students, the target stimuli were white cards (7cm x 13cm) with drawings on them. Pie shapes, divided squares, and groups of objects were pictured and a portion of the drawing was shaded. For two children, there were two drawings on each card and an addition sign between the drawings forming an equation. The non-target stimuli were printed on the back of the target stimuli cards. The related stimuli were percentages that corresponded to the portion of the drawing that was shaded. The unrelated non-target stimuli were line drawings of the outlines of selected states. The stimuli used are shown in Table 1. In addition, during instruction, the students received an edible reinforcer for correct responses (e.g., M&M's, small cookies, candy corn, etc.).

Insert Table 1 about here

Materials used during probe sessions were cards with stimuli identical to those used in instruction. However, the cards had the stimuli printed on one side only. Probes on the related instructive feedback information (the percentages) were given verbally by the teacher.

Procedures

Experimental design. An adapted alternating treatments design was used (Sindelar, Rosenberg, & Wilson, 1985). It is a variation of the alternating treatments design in which treatments are applied to independent but equally difficult behaviors. Two sets of shaded drawings (three per set) were assigned to each subject. Baseline probes determined that the sets were unknown. One set was taught using constant time delay and adding related information on each trial through instructive feedback. The other set was taught using constant time delay and adding unrelated information on each trial through instructive feedback. One session was conducted each day, alternating conditions over days.

General procedures. Initially, all students were screened to identify unknown stimuli. The target stimuli were divided into two sets. Prior to instruction, two probe conditions were implemented. The first assessed students' performance on target behaviors and the second assessed their performance on both sets of instructive feedback stimuli. Instruction was then implemented in one session per day with each condition presented every other day. After criterion level performance was established (any three days per condition at 100% unprompted correct responses plus two days at variable reinforcement every third trial-VR3), a check of target acquisition was conducted and, if the student evidenced 100% acquisition, target and non-target information probe conditions were implemented.

The students were taught to name the fractions that corresponded to the shaded drawings (target behavior). The instructive feedback information was given both verbally and visually. They were taught in a 1:5 instructional arrangement. As each student met criterion, they were removed from the group. The teacher presented the full group with 30 trials per session (2 trials x 3 stimuli for each child). As each child exited the group or if a child was absent, the session was shortened by 6 trials. Three of the students received the same three stimuli in each condition and two of the students had two different sets of stimuli. This was due to the differing levels of entry skills.

Pre-training target probe condition procedures. Prior to instruction, each student was tested individually to ensure that the target stimuli to be taught were unknown. Three sessions were conducted over three days. In each session, the student was asked to name a fraction that corresponded to the shaded drawings. The fractions for the two conditions were intermixed. Three trials per stimuli were delivered yielding 18 trials per session (3 trials per 6 stimuli). The teacher presented an attentional cue ("Ready," or "Look," etc.), and, if the child responded affirmatively, the instructor delivered the task direction (e.g., "What portion of this drawing is shaded?"), and provided a response interval of 4 seconds (counting silently

"1001, 1002, 1003, 1004"). For all responses, the teacher gave a non-judgmental response such as "OK" or "We'll learn that later." After an intertrial interval of 2 to 5 seconds, the next trial was presented.

Pre-training instructive feedback probe condition procedures. Each student was tested to ensure that the instructive feedback stimuli were unknown. These sessions were conducted individually, over three days, in separate sessions for the related and unrelated instructive feedback stimuli. In each condition, three trials per stimuli were delivered and three distractor stimuli were added yielding 12 trials per session. For the related instructive feedback probes, the student was asked to state a percentage that corresponded to a fraction that the teacher verbally stated. For the unrelated instructive feedback stimuli the student was asked to look at a line drawing of the outline of a state and to name it expressively. The teacher delivered the trials in a manner consistent with the procedures for the target probe condition. She presented an attentional cue, delivered the task direction (i.e., "What percentage equals (fraction)?" or "What is this?" for the states), provided a response interval of 4 seconds, gave a non-judgmental response and an intertrial interval of 2-5 seconds.

Instructional procedures. A constant time delay procedure with instructive feedback for correct responses was used. Constant time delay includes two types of trials: 0-second and delay. The 0-second trials involve presentation of the task direction immediately followed by delivery of a controlling prompt (i.e., one that will ensure that the child responds correctly). In this study, the teacher ensured that the student was attending, presented the card and the task direction ("What portion of this drawing is shaded?"), and immediately followed the question by a verbal model of the correct response (the fraction name). The student then imitated the correct response. If the student imitated the target information correctly, the instructor praised the child, and delivered a reinforcer. The instructor then turned the card and showed the reverse side which contained the respective instructive feedback stimuli, and said, "(Percentage) equals (the fraction)" in the related condition, or "And this is (state)." in the unrelated condition. No response was required from the child and no consequence was provided for the instructive feedback statement. If there was an error or no response, the instructor modeled the correct response and allowed the child to imitate.

Beginning with the second session, delay trials (4 seconds) were introduced. The delay trials were identical to the 0-second trials with two exceptions. First, a 4-second response interval was inserted after the task direction and before the controlling prompt. Second, at the beginning of the session, the children were instructed to respond if they knew the answer, and, if they did not know, they were to wait for the prompt. Consequences for correct responses were identical to those for the 0-second trials. The instructive feedback information was presented following all trials in which there was a correct response. If there was an error before or after the prompt, or no response after the prompt, the teacher did not present the instructive feedback stimuli but waited the intertrial interval and proceeded with the next trial.

Five responses were possible. The students could (a) state the fraction correctly before the prompt--unprompted corrects, (b) state the fraction correctly after the prompt--

prompted corrects, (c) state anything other than the correct fraction before the prompt--unprompted errors, (d) state anything other than the correct fraction after the prompt--prompted errors, or (e) they could give no response after the prompt.

Post-training target check procedures. Upon reaching criterion in both conditions, the student was given one probe session on the target stimuli intermixed from both conditions. These target checks were conducted individually to ensure that the students had acquired the skills to respond correctly and that correct responses during training did not reflect imitation of the responses of other students. Twelve trials (two per stimuli) were delivered with the following procedure: The teacher ensured that the student was attending, presented the stimulus, delivered the task direction (i.e., What portion of this drawing is shaded?"), and provided a 4-second response interval. A non-judgmental response such as "OK" followed all responses, and an intertrial interval of 2-5 seconds was used. If the student's performance level was at 100% correct responding, then the target probes were implemented.

Post-training target probe condition procedure. Target probes consisted of three trials each of the stimuli from both conditions to assess acquisition of the behaviors taught through constant time delay procedures. The students received three sessions over three days. The teacher ensured that the student was attending, presented the stimulus, delivered the task direction (i.e., What portion of this drawing is shaded?"), gave a non-judgmental response such as "OK", and waited an intertrial interval of 2-5 seconds.

Post-training instructive feedback information probe condition. Non-target information probes assessed children's acquisition of the extra information that was provided through instructive feedback. These probe sessions were conducted individually and occurred after the students achieved criterion level performance in training and 100% correct responding on a target check probe. The students were assessed on the acquisition of the related and the unrelated stimuli. Two measures occurred, one for related stimuli and one for unrelated stimuli, and each were collected in three sessions over three days. The teacher followed the procedures outlined above: gaining attention, presenting the stimuli (a verbally stated fraction and an outline drawing of a state), delivering the task direction ("What percentage equals (fraction)?" and "What is this?"), providing a 4-second response interval, giving a non-judgmental response, and waiting the intertrial interval.

Reliability

Interobserver agreement checks occurred for children's responses (Tawney & Gast, 1984) and procedural reliability checks were conducted to measure consistency of the instructor's implementation of the procedure (Billingsley, White, & Munson, 1980). The following behaviors were checked for procedural reliability: ensuring student attention, showing the correct stimuli, giving task directions, waiting appropriate response interval, providing the model, praising correct responses or ignoring errors, providing the correct instructive feedback, and waiting the correct intertrial interval.

Results

Reliability

For student responses, the percentages of interobserver agreement were calculated using the point-by-point method (number of exact agreements divided by the number of exact agreements plus the number of disagreements and the quotient was multiplied by 100). For probe conditions, interobserver agreement was assessed on 22% of the sessions, and in all cases was 100%. In the instructional conditions, interobserver agreement was assessed on 45% of the sessions and in all cases was 100%.

Procedural reliability was assessed on 22% of the probe conditions and 42% of the related instructional conditions and 47% of the unrelated instructional conditions. Procedural reliability was calculated by dividing the numbers of actual teaching behaviors by the number of planned teacher behaviors and multiplying by 100 (Billingsley et al., 1980). During probes, all aspects of the procedure were at 100%. During instruction in the related condition, all were at 100% except for waiting appropriate interval (99.5%; range 96.6-100%) and praising correct responses or ignoring errors (95.2%; range 73.3-100%). During instruction in the unrelated condition, all aspects of the procedure were at 100% except for showing the correct stimuli (99.1%; range 95.8-100%), waiting the appropriate response interval (99.1%; range 96.6-100%), and praising correct responses or ignoring errors (97%; range 94.4-100%).

Effectiveness and Efficiency of Instruction for Target Behaviors

Constant time delay with instructive feedback was effective in teaching the target behavior, naming the fractions pictured in shaded drawings, to all five students. The training data are shown in Figure 1. All students reached criterion level responding in both conditions.

Insert Figure 1 about here

Efficiency was measured in terms of number of trials and time through criterion and number and percentage of errors during training. The totals for these measures are shown in Table 2. The number of trials per students was low. The time in training reflects not only the time to train the specific student but the time spent in the group observing the trials and instructive feedback of other students. The number of errors is low (mean 2.3%; range 0-7) yielding error percentages of 0% to 6.1% (mean of 2.8%).

Insert Table 2 about here

The number of trials through criterion for acquisition of target behaviors with related instructive feedback stimuli and with unrelated instructive feedback stimuli are shown in Table 2. One student, Chad, had an equal number of trials in both conditions. Each of the other four students reached criterion in fewer trials in the related instructive feedback condition.

Acquisition of Instructive Feedback Stimuli

All five students had higher acquisition levels for the stimuli presented in the unrelated condition. The results are shown in Figure 2. Linda, Alex, and Courtney achieved 100% correct response levels for the unrelated behaviors. Tyler had 92.5% and Chad had 62.9%. The levels of acquisition of behaviors seen in instructive feedback in the related condition were 3.7% for Tyler, Chad, and Courtney, 14.8% for Alex, and 18.5% for Linda.

Insert Figure 2 about here

Discussion

The purpose of this study was to compare acquisition of two types of instructive feedback stimuli--related information and unrelated information. The findings indicate that the students acquired behaviors presented in instructive feedback that were unrelated to the target behaviors, and in this instance, the responses were at a higher level than the related behaviors. Comments made by the students during training and probe sessions indicated that they "liked" the state stimuli better than the percentages and that they perceived them to be "easier to remember." To determine whether the results were due to the unrelated nature of the instructive feedback or more indicative of the interest or the difficulty of the academic material, a second experiment was conducted.

Experiment II

Experiment II questioned again the conditions under which instructive feedback could be optimally acquired. In Experiment I, students showed that they could acquire instructive feedback that was unrelated to the target behaviors being taught, or from a different academic domain. In the second study, the type of stimuli in instructive feedback that had been related was placed in an unrelated condition and the type of behavior that had been unrelated was placed in a related condition by changing the nature of the target material. The students were taught to respond with the name of the state when shown the printed name of the state capital city. The related behaviors shown in instructive feedback then became the outline of the state, the unrelated behaviors were percentages that were equal to a given fraction. The specific question became: Given a history with the technique and placing a previously related information type in the unrelated condition, can students acquire more stimuli presented through instructive feedback if those stimuli are related (from the same academic domain) or unrelated (from a different academic domain) to the target behaviors?

Subjects and Setting

The subjects and setting were identical to those in Experiment I.

Materials

The materials for Experiment II were similar to those for Experiment I, differing in content of the target and instructive feedback stimuli. The target behaviors were changed to alter the conditions assigned to the percentages and the state outlines (instructive feedback information). For all students, the target stimuli were white cards (7 cm x 13 cm) with names of state capitals printed in black, 36 point, Times Roman type. The instructive feedback stimuli were presented on the reverse sides of the cards. For the related instructive feedback stimuli, black line drawings of outlines of the states were presented. For the unrelated stimuli, an equation was printed in black, 36 point, Times Roman type. It was of the form: (fraction) = (percentage). All students were shown the same stimuli. The stimuli are shown in Table 1.

Procedures

Experimental design. The design of the experiment was identical to that used in Experiment I.

General procedures. The procedures were the same as those used in Experiment I. The students were taught to name a state that corresponded with the name of a capital city. The instructive feedback information was given both verbally and visually. All students were taught the same sets of behaviors.

Pre-training target probe conditions procedures. The procedures for these probes were similar to those used in Experiment I, differing in the behaviors probed and in the task directions. In each of the sessions, the student was asked to name the state that corresponded to the capital city. The teacher presented the task direction: "(City) is the capital of a state. What state?". All other aspects of the procedure remained the same.

Pre-training instructive feedback probe condition procedures. These procedures were similar to those used in Experiment I, again differing in the behaviors that were probed and in the task directions. For the related instructive feedback probes, the students were asked to name a state when they were shown a black line outline drawing. For the unrelated instructive feedback probes, the students were asked to state a percentage that equaled a fraction the teacher verbally stated. The teacher followed the procedures outlined for Experiment I, using the task directions: "What is this?" or "What percentage equals (fraction)?"

Instructional procedures. Constant time delay procedures with instructive feedback for correct responses were used. The teacher followed the outlined procedures for both 0-second trials and for delay trials, presenting the target behavior stimuli cards with the task direction:"(City) is the capital of a state. What state?".

The five responses that were possible included: (a) verbally naming the state correctly before the prompt--unprompted corrects, (b) verbally naming the state correctly after the prompt--prompted corrects, (c) verbally naming anything other than the correct state before the prompt--unprompted errors, (d) verbally naming anything other than the correct state after the prompt--prompted errors, or (e) they could give no response after the prompt.

Post-training target check procedures. These checks were similar to those in Experiment I differing only in the behaviors probed and in using task direction appropriate to the behaviors.

Post-training target and instructive feedback information probe condition procedures. These procedures also were similar to those in the previous experiment, differing in behaviors probed and in using the appropriate task directions.

Reliability. Reliability checks were conducted in the same way as those for Experiment I.

Results

Reliability

For student responses, the percentages of interobserver agreement were calculated using the point-by-point method (as in Experiment I). For probe conditions, interobserver agreement was assessed on 26% of the sessions, and in all cases was 100%. In the instructional conditions, interobserver agreement was assessed on 22% of the sessions and in all cases was 100%.

Procedural reliability was calculated as in Experiment I and was assessed on 26% of the probe conditions and 23% of the related instructional conditions and 20% of the unrelated instructional conditions. During probes, all aspects of the procedure were at 100%, except for waiting the appropriate response interval (98.5%; range 88.8-100%). During instruction in the related condition, all were at 100% except for praising correct responses or ignoring errors (99.4%; range 96.6-100%). During instruction in the unrelated condition, all aspects of the procedure were at 100% except for praising correct responses or ignoring errors (99.2%; range 96.6-100%).

Effectiveness and Efficiency of Instruction for Target Behaviors

Constant time delay with instructive feedback was effective in teaching the target behavior, naming the state to correspond with the capital city, to all five students. The training data are shown in Figure 3. All students reached criterion level responding in both conditions.

Insert Figure 3 about here

Efficiency was measured in terms of number of trials and time to criterion and number and percentage of errors during training. The totals for these measures are shown in Table 2. The number of trials per student was higher for Experiment II than for Experiment I. The time in training reflects not only the time to train the specific student but the time spent in the group observing the trials and instructive feedback of other students. The number of errors was low (0-10) yielding error percentages of 0% to 7.6% (mean of 3.3%). The number of trials through criterion for acquisition of target behaviors with related instructive feedback stimuli and with unrelated instructive feedback stimuli also are shown in Table 2. One student, Courtney, had slightly more trials (6) in the related condition than in the unrelated. Each of the other four students reached criterion in fewer trials in the related instructive feedback condition.

Acquisition of Instructive Feedback Stimuli

The results are shown in Figure 4. Linda, Tyler, and Courtney had 100% acquisition of the unrelated behaviors. Alex had 55.5% and Chad had 0%. The level of acquisition of behaviors seen in instructive feedback in the related condition were higher than those seen for unrelated behaviors except for Tyler. He evidenced acquisition of 18.5% of the related behaviors (state names). Linda and Courtney had 100% acquisition of the behaviors, Alex had 92.5% and Chad had 77.7%.

Insert Figure 4 about here

Discussion

Two students (Linda and Courtney) acquired all the instructive feedback stimuli for both conditions; two students (Alex and Chad) had higher percentages of correct responses on the related instructive feedback stimuli; and one student (Tyler) had higher percentages of correct responses on the unrelated instructive feedback stimuli. These results lead to the conclusion that some factor other than relatedness (i.e., being within the same academic domain) contributed to the acquisition of the instructive feedback stimuli.

Tyler did not follow the pattern of the other students in Experiment II. In both Experiments, he acquired more behaviors in the unrelated condition. Linda's and Courtney's performances also were at 100% for the unrelated behaviors and for the related behaviors. For these three students, a case could be made for the novelty of the unrelated stimuli being a factor in the acquisition. Chad and Alex did not follow this pattern. Although Alex learned some of the behaviors in each condition, his performances on the related behaviors (state names) was higher than for the unrelated (percentages). Chad acquired a similar level of the state naming behavior in Experiment II (in which it was related) as he did in Experiment I (in which it was unrelated). These two students may have shown a preference for the type of material rather than for the related or unrelated nature of it.

General Discussion

The purpose of these studies was to determine whether students would acquire more stimuli presented through instructive feedback if those stimuli were related (from the same academic domain) to the target behaviors (i.e., those being taught directly) as compared to unrelated (from a different academic domain). The results indicate several findings. First, constant time delay procedures were effective in teaching the target behaviors, naming a fraction to correspond to a shaded drawing and naming a state to correspond to a capital city, to all five students.

Second, behaviors shown in instructive feedback conditions that were unrelated to the target behaviors were acquired. In Experiment I, all five of the students acquired a large portion of the behaviors presented in the unrelated condition. However, they acquired a low percentage of those in the related condition. These performances can be compared to those in the Gast et al. (1992) study, in which some behaviors (the name of the streets on which buildings were located) were acquired only when presented as one piece of instructive feedback but were not acquired when the activity that occurred in the building was included as a part of the feedback. Interest in or ease of learning may be a factor. To determine whether these factors were in play, Experiment II was conducted. The students were given the same instructive feedback behaviors, percentages equal to a fraction and the outlines of a state, but the target behavior, naming a state to correspond with a state capital, resulted in the state outline being the related condition and the equation involving a percentage being the unrelated. If interest or ease of learning contributed to the state outline being learned in Experiment I, then the students might be expected to acquire the state names but not the percentages in Experiment II. For Tyler this was the case, but for the other four students, the state names (in this case, the related behaviors) were again acquired at a level higher than for the percentages.

Third, the target behaviors that were followed by related instructive feedback were acquired with slightly fewer numbers of trials. In Experiment I, comparing only the number of trials delivered per student, the mean for the related condition was 12 trials less than for unrelated (the equivalent of two days of instruction). In Experiment II, the differences between the means was 19.2 (slightly more than three sessions of instruction). The target stimuli in the two conditions were similar to each other and were the same for all students. However, it is not possible to determine whether these results were due to unequal difficulty in the target behaviors or whether they are due to an interaction of the type of instructive feedback. Clearly, more research to clarify this effect is necessary.

Fourth, history with instructive feedback may be a strong factor in determining children's ability to acquire instructive feedback stimuli. When the amount of instructive feedback is summed across both conditions in each experiment, all students had higher percentages in Experiment II as compared to Experiment I. This finding is not surprising given that history with instructional procedures has repeatedly been demonstrated to increase the efficiency and effectiveness of instruction (Wolery, Ault, & Doyle, 1992).

The implications of this study for practice appear to be twofold. First, as in previous studies of instructive feedback (e.g., Gast et al., 1991; Wolery, Holcombe, et al., in press; Wolery, Werts, et al., in press), students acquired some of the instructive feedback without direct training; thus, teachers are encouraged to include instructive feedback in their direct instructional efforts. Second, the identification of the instructive feedback stimuli need not be related to the academic domain being taught directly. Thus, stimuli that are important for students to learn should be presented through instructive feedback.

However, this study raises interesting questions for future research with instructive feedback. Two lines of research appear fruitful. First, attention should be given to factors related to the instructive feedback stimuli. Specifically, the effects of novelty, students' interest in or preference for stimuli, and difficulty of the stimuli need to be more clearly delineated. In Experiment I, the students clearly learned more of the unrelated instructive feedback stimuli than the related stimuli. This may have been due to their novelty (i.e., being different from the other experimental stimuli), to their difficulty (i.e., perhaps naming the state outline was easier than naming the percentage that equaled the fraction that was directly taught), to students' preference or interest in states, or to a combination of these factors. Based on research on direct instruction, each of these factors would appear to be related to more rapid acquisition. For example, novel stimuli may be more rapidly acquired because they are likely to engender more attention than familiar or similar stimuli. Further, children are likely to acquire skills more rapidly when they have an interest or preference for the stimuli rather than those that are less interesting or those they do not prefer. Finally, by definition, students acquire easier rather than more difficult tasks more rapidly. Thus, these factors also may influence the amount of learning that occurs with instructive feedback stimuli. However, carefully controlled studies of these assumptions have not been conducted.

Second, several issues related to the presentation of the instructive feedback stimuli deserve investigation. In these two experiments and in all other instructive feedback studies, the instructive feedback was presented on every trial that resulted in a correct response to the target stimuli. It is not known whether intermittent presentation of instructive feedback stimuli would produce similar results. One could predict that intermittent presentation would produce equal learning if novelty was a salient feature controlling the acquisition of instructive feedback stimuli; however, it is also possible that intermittent presentation would not produce adequate exposure to the stimuli for stimulus control to be established. Similarly, in these two experiments and in other instructive feedback studies, the format of the instructive feedback stimuli were identical across all trials. For example, the color and size of the state outlines for a given state were identical on all trials. It is unknown whether varying the size or color of the state outline might produce greater attention to the instructive feedback stimuli and thus more acquisition of those stimuli. However, this is an issue of considerable importance because it may be related to the amount of generalization that would occur across various forms of the instructive feedback stimuli. Clearly, considerable future research is needed to give guidance to teachers on both the selection of instructive feedback stimuli and the presentation of such stimuli.

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Table 1

Stimuli Used During Instruction in Experiments I and II

	Stimuli		
Experiment	Target	Related	Unrelated
Experiment I	1/7	14%	--
	2/5	40%	--
	4/5	80%	--
	1/5 + 2/5[1]	60%	--
	2/6 + 3/6[1]	83%	--
	1/4 + 2/4[1]	75%	--
	1/3	--	Louisiana
	5/8	--	Virginia
	1/6	--	Nebraska
	2/8 + 5/8[1]	--	Missouri
	3/7 + 1/7[1]	--	Kentucky
	1/3 + 1/3[1]	--	Oklahoma
Experiment II	Juneau	Alaska	--
	Olympia	Washington	--
	Montgomery	Alabama	--
	Madison	--	6/7 = 86%
	Cheyenne	--	1/5 = 20%
	Phoenix	--	1/9 = 11%

[1] These stimuli were presented to Chad and Linda.

Table 2

Efficiency of Instruction for Target Behaviors

Experiment/ Student	Number of Trials		Time to Criterion		Number of Errors		Percent of Errors	
	Related	Unrelated	Related	Unrelated	Related	Unrelated	Related	Unrelated
Experiment I								
Linda	72	90	62:24	75:07	0	4	0.0	4.4
Courtney	90	114	67:30	90:35	3	7	3.3	6.1
Chad	96	96	70:29	82:00	3	1	3.1	1.0
Alex	66	72	62:02	71:29	1	0	1.5	0.0
Tyler	48	60	43:56	61:45	2	2	4.1	3.3
Experiment II								
Linda	54	60	46:43	67:44	1	0	1.8	0.0
Courtney	144	138	103:52	128:15	3	10	2.0	7.2
Chad	78	132	69:35	137:51	0	10	0.0	7.6
Alex	120	138	98:41	137:51	1	2	0.8	1.4
Tyler	102	126	80:14	120:48	2	7	1.9	5.5

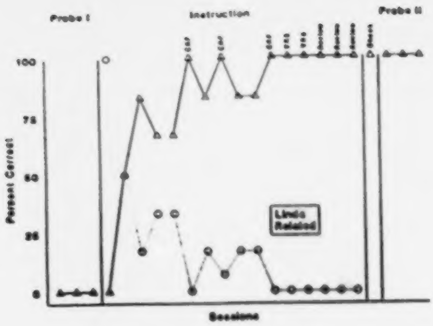
Figure Captions

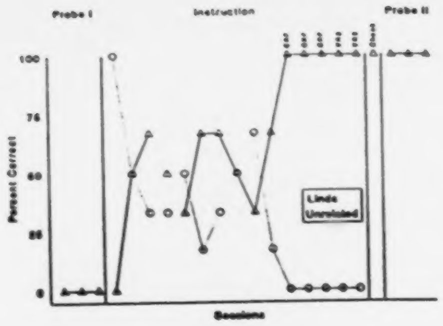
Figure 1. Percent of correct anticipations (triangles) and correct waits (circles) for training and probe sessions on target behaviors with related and unrelated instructive feedback stimuli during Experiment I.

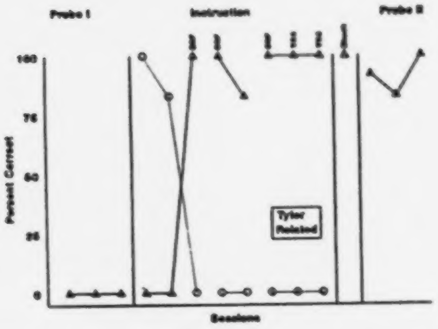
Figure 2. Percent of acquisition of related and unrelated instructive feedback stimuli for the five students in Experiment I.

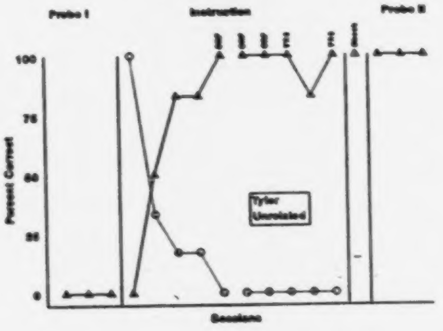
Figure 3. Percent of correct anticipations (triangles) and correct waits (circles) for training and probe sessions on target behaviors with related and unrelated instructive feedback stimuli during Experiment II.

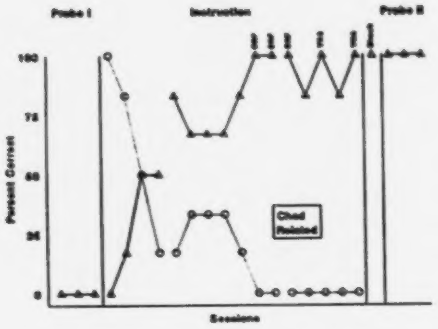
Figure 4. Percent of acquisition of related and unrelated instructive feedback stimuli for the five students in Experiment II.

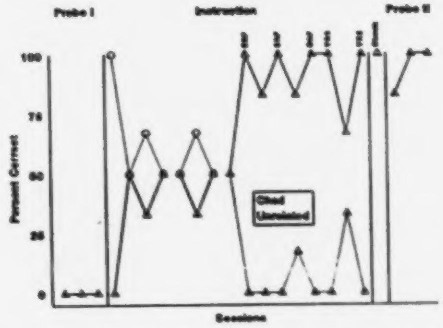


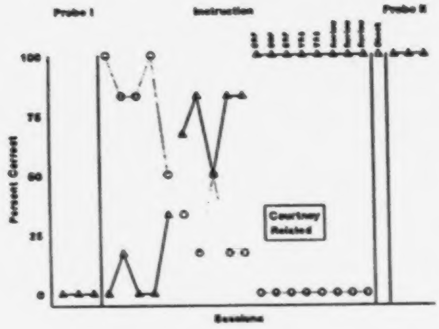


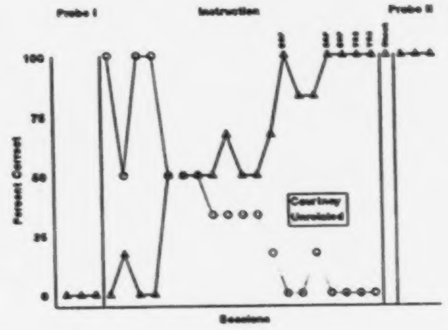


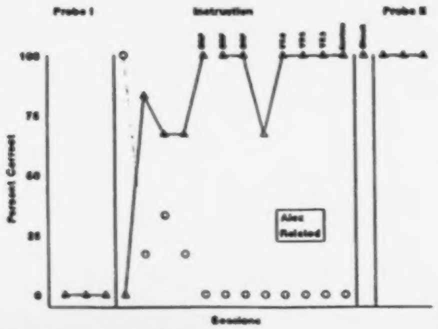


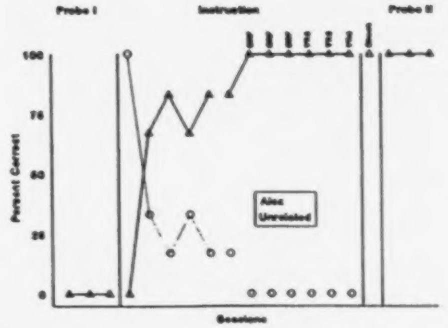












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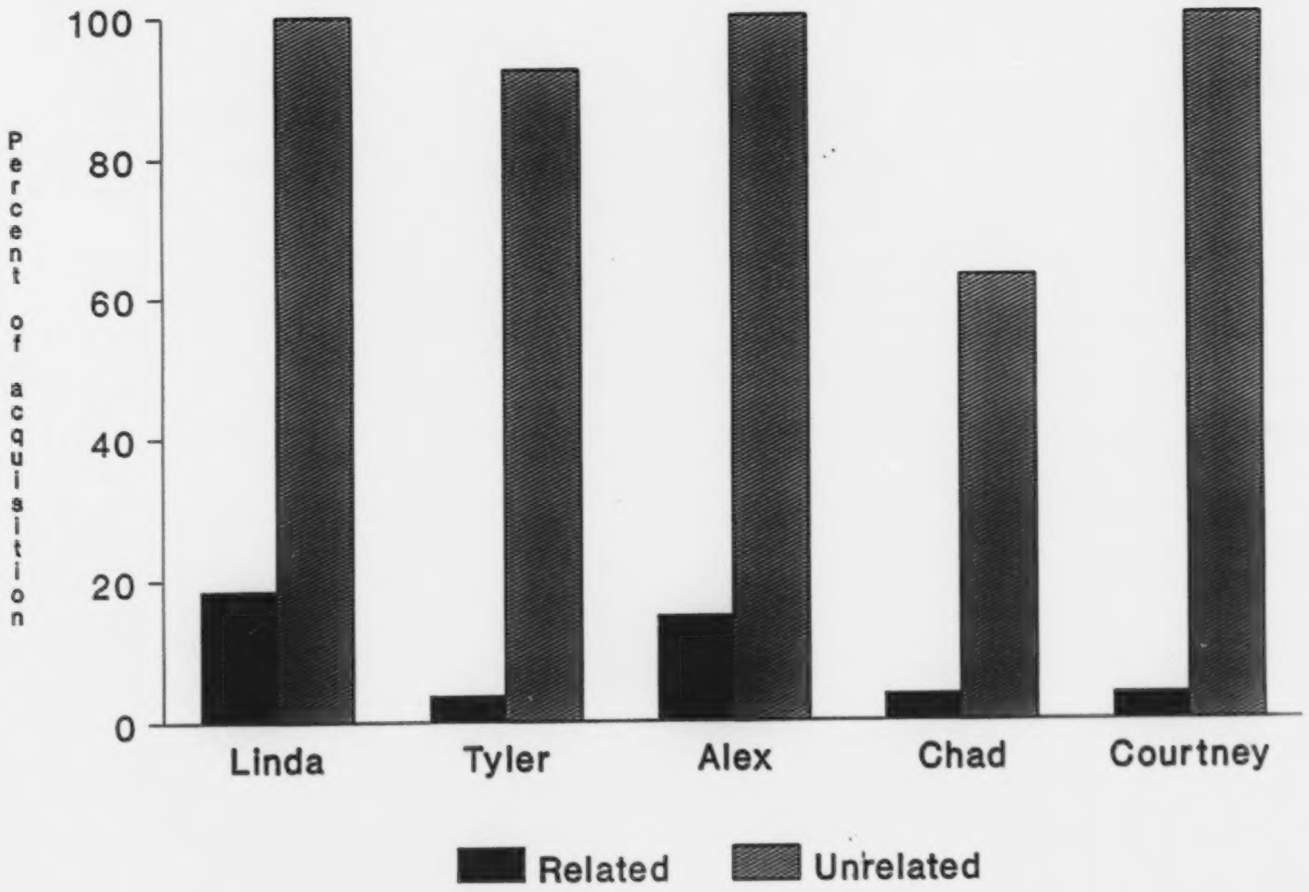
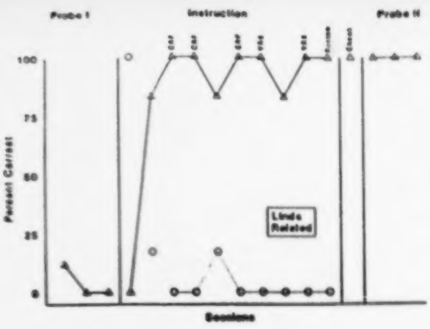
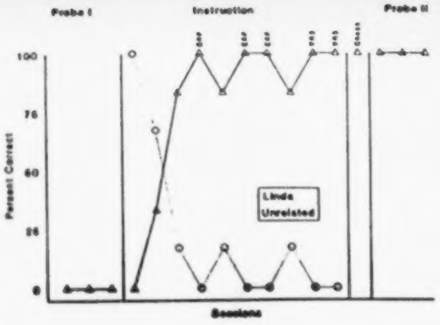
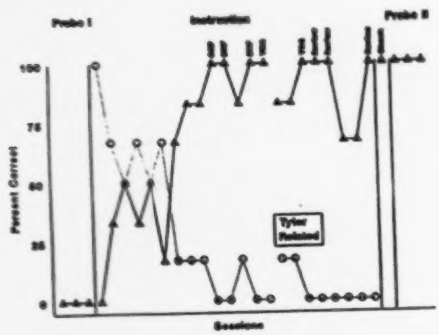
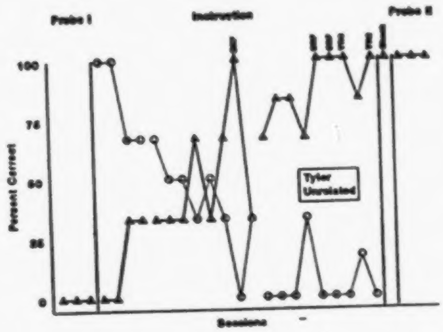
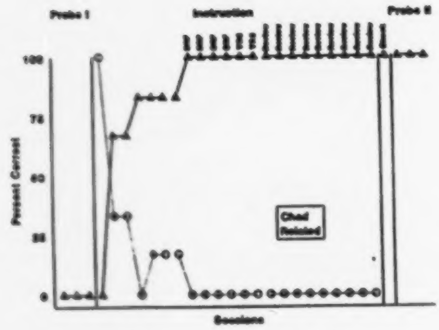

100
80
60
40
20
0
Percent of acquisition
Linda
Tyler
Alex
Chad
Courtney
Related
Unrelated

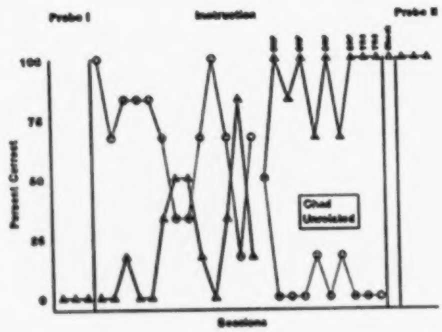


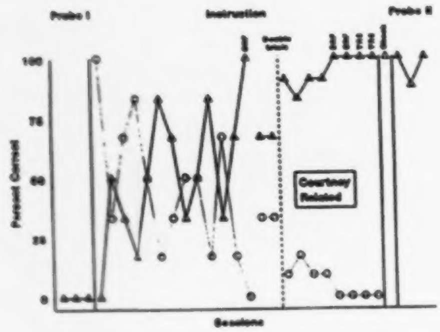


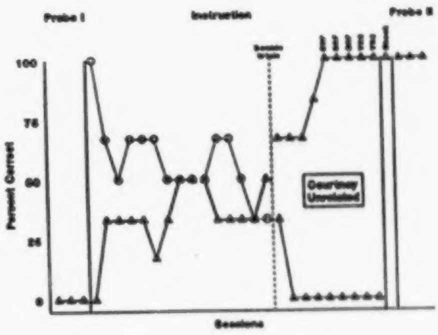


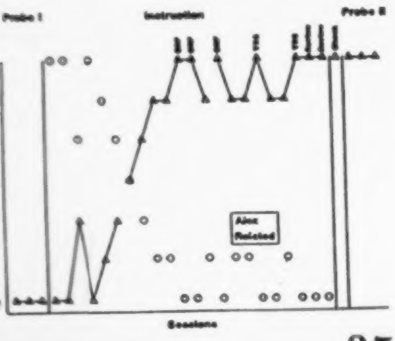


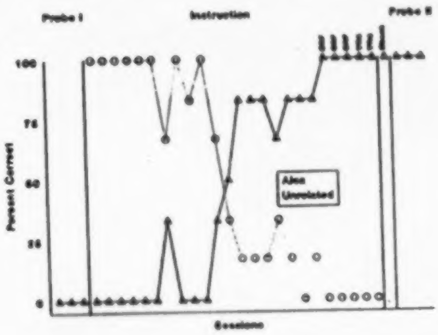












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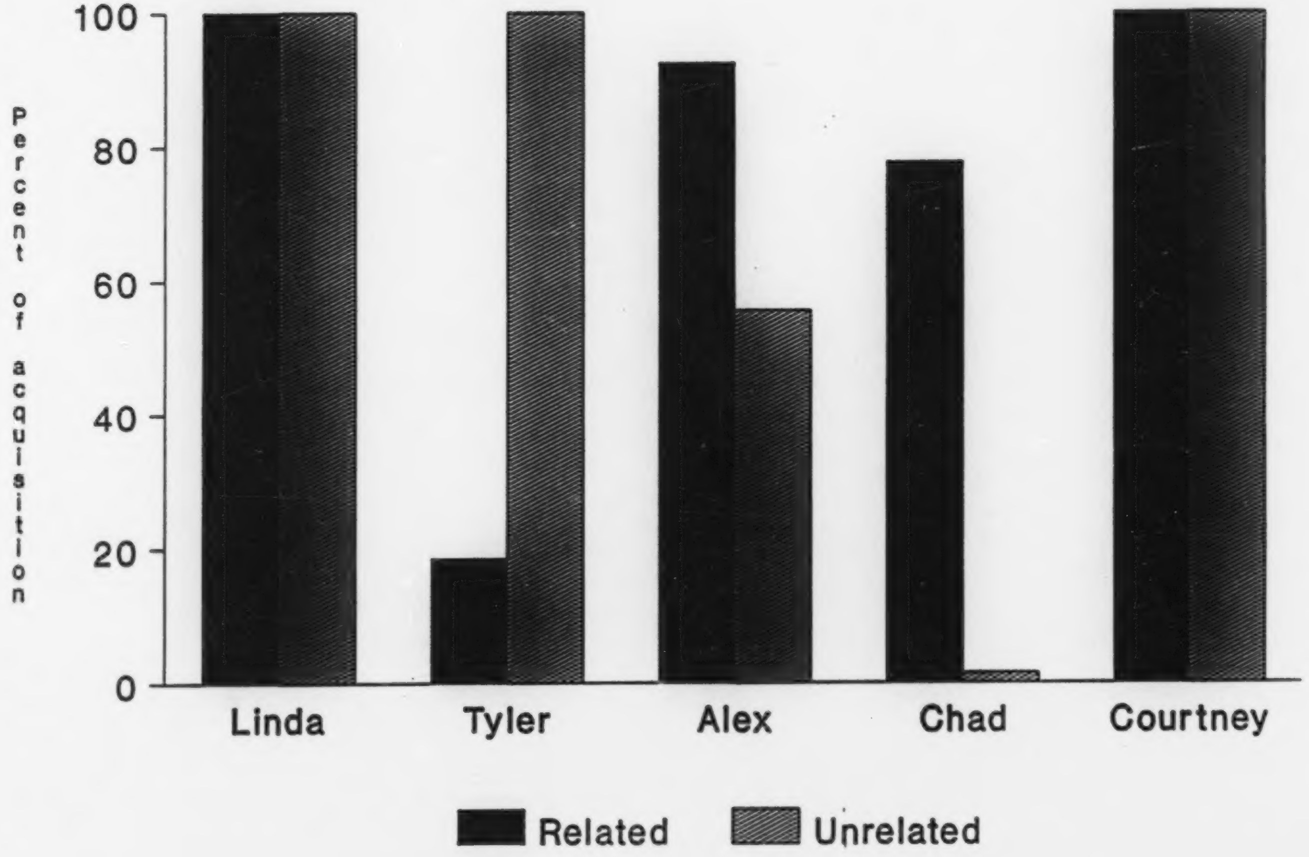
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Appendix M

Instructive Feedback: A Comparison of Simultaneous and Alternating Presentation of Non-Target Stimuli

Instructive Feedback: A Comparison of Simultaneous and Alternating Presentation of Non-Target Stimuli

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Abstract

Instructive feedback involves presenting extra, non-target stimuli in the consequent events for children responses. Two methods of presenting instructive feedback during direct instruction were compared. These methods involved presenting two extra stimuli on all trials, and presenting the two extra stimuli separately on alternating trials. Preschool students were taught coin combinations using a constant time delay procedure with instructive feedback stimuli added to both praise and correction statements. An adapted alternating treatments design was used to evaluate the two methods of presenting instructive feedback. The students were assessed to determine the extent to which instructive feedback stimuli were learned. The results indicate that students learned some of the instructive feedback stimuli and no consistent differences in the effectiveness of the two presentation methods were noted. Further, relationships between the two instructive feedback stimuli appeared to be established. Implications for instruction and future research are discussed.

Instructive Feedback: A Comparison of Simultaneous and Alternating Presentation of Non-Target Stimuli

In an era of educational reform, teachers must ensure that their methods are effective and efficient. One measure of efficiency is whether teaching strategies provide opportunities for learning extra information that leads to broader knowledge (Wolery, Ault, & Doyle, 1992). A strategy that enables students to learn behaviors that are not taught directly and that requires negligible additional instructional time and effort would be deemed efficient.

To increase the efficiency of instruction, several studies have used a procedure called instructive feedback. Instructive feedback involves presenting additional, nontarget information (stimuli) in the consequent events of direct instructional activities. After acquisition is achieved on target responses, students are assessed to determine whether they acquired the information presented through instructive feedback. Instructive feedback has been used with secondary-aged students who had moderate to severe mental retardation (Doyle, Gast, Wolery, Ault, & Farmer, 1990), elementary-age children with moderate mental retardation (Gast, Wolery, Morris, Doyle, & Meyer, 1990), elementary-age students with mild mental retardation (Gast, Doyle, Wolery, Ault, & Baklarz, 1991), preschool students with communication and hearing impairments (Werts, Wolery, Holcombe-Ligon, Vassilaros, & Billings, 1992), and preschoolers with developmental delays and moderate mental retardation (Wolery, Holcombe-Ligon, Werts, & Cipolloni, in press). In each of these studies, one stimulus for each target behavior was presented through instructive feedback. In two studies with elementary-aged students with mild handicaps, two stimuli were presented through instructive feedback for each target behavior. Gast, Doyle, Wolery, Ault, and Baklarz (1992) used instructive feedback to deliver one or two extra stimuli to photo naming of places in the community. The extra stimuli were either the address or the activity that occurred in each place. When the address was presented alone, students learned it; however, when the address and activity were presented together, they only learned the activity. When two activities were presented, they learned both. Harrell, Wolery, Ault, DeMers, and Smith (1992) also presented two stimuli for each target behavior through instructive feedback. Students were taught to say an antonym, and they were shown the written word and told a brief definition. Most students learned some of both; however, reading the word occurred at higher percentages than stating the definition.

Questions remain about how to present multiple stimuli through instructive feedback and about how many behaviors can be presented. For older students, it has been reported that 6 to 8 items or "chunks" were the optimum number of facts that could be learned efficiently (Deese & Hulse, 1967; Miller, 1956). Furukawa (1970) found that college students learned foreign words more efficiently in "chunks" of seven words. Johnson, Gersten, and Carnine (1987) used computer aided instruction to introduce vocabulary and found that students who learned three words at a time with periodic reviews learned more effectively than those who saw all 25 words in the list at one time. Gleason, Carnine, and Vala (1991) studied the efficiency of rapid introduction of items versus cumulative introduction. They used seven "chunks" of information with elementary students with learning disabilities and found more efficient learning when three "chunks" were presented in a group and then reviewed, rather than presenting all seven and reviewing. No studies were found that addressed the amount of information optimum for simultaneous presentation with preschoolers and, specifically, preschoolers with identified disabilities.

When instructive feedback was used with preschoolers who had disabilities, they learned both the target behaviors and some of the instructive feedback stimuli (Werts et al., 1992; Wolery et al., in press). However, in both studies, only one stimulus for each target behavior was presented through instructive feedback, and none of the instructive feedback studies (regardless of student age) addressed methods of presenting two stimuli for each target behavior.

In this study, two stimuli for each target behavior were presented through instructive feedback on instructional trials. The two stimuli were presented through two methods (a) the two stimuli were shown simultaneously on one card for each trial (simultaneous presentation), and (b) the two stimuli were shown separately on alternating trials (alternating presentation). The research questions asked were: (a) Will preschool students with identified handicaps learn to name the values of coin combinations (target behavior) and the stimuli presented through instructive feedback?; and (b) Will they learn more if the instructive feedback are presented simultaneously on every trial or separately on alternating trials?

Methods

Participants

Five students (2 girls and 3 boys) from a classroom for preschool children with language delays and/or hearing impairments participated in the study. They ranged in age from 55 to 61 months at the onset of the study. Four of the children were identified as speech/language delayed and one as hearing impaired. One student had a hearing aid and was identified as having a mild to moderate loss. All were verbal and responded to verbal instructions from the investigator.

Emily was a 4-year-11-month caucasian girl from a lower-middle income home. She was enrolled in the program due to speech/language delays. Testing within 1.5 years of the onset of the study found her expressive language to be limited to approximately 20 words. She communicated by gesturing and pointing. She received a score of 96 on a Stanford-Binet Intelligence Test (Terman & Merrill, 1973) (basal at III and ceiling at IV-6), failing only items that required a verbal response; she passed Picture Naming at the III level. Her fine motor skills were age-appropriate, but she exhibited a mild gross motor delay in that she did not pedal a tricycle or alternate feet when walking up stairs. Her eyesight and hearing were within the normal ranges for her age. On the Test of Visual Motor Integration (Beery, 1967), she scored in the average range. On the Vineland Adaptive Behavior Scales (Sparrow, Balla, & Cicchetti, 1985), her adaptive score was 80, or moderately low. Expressive language, as measured by the Expressive One-Word Picture Vocabulary Test (Gardner, 1979), was at the 8th percentile and her score on the Khan-Lewis Phonological Analysis (Khan & Lewis, 1986) was at the 4th percentile. She exhibited many speech substitutions and omissions. She was given a Wechsler Preschool Primary Scale of Intelligence-Revised (WPPSI-R) (Wechsler, 1974) immediately prior to the onset of the study and received a

Performance IQ of 109, a Verbal IQ of 110, and a full scale IQ score of 111.

Matthew was a 4-year-7-month African American boy from a lower-middle income home. He had been placed in the preschool due to hearing and language problems. He used an amplification device in the classroom (Phonic Ear), and the adults in the class wore a microphone to facilitate his communication. He had been diagnosed as having a mild to moderate impairment in his right ear, with mixed conductive sensorineural hearing loss in the mid- to high-frequency range. He could hear normal speech but had difficulty with background noises and soft or high speech sounds. He was adept with the use of his hearing aid. He was given a WPPSI-R at the onset of the study and received a Performance IQ of 94, a Verbal IQ of 97, and a full scale IQ score of 95.

Kevin was a 5-year-1-month caucasian boy from a lower-middle income home. He was described as having an expressive language delay. He had a moderate to severe articulation disorder and spoke primarily in vowels. His receptive language, as measured by the Peabody Picture Vocabulary Test-Revised (PPVT-R) (Dunn & Dunn, 1981), was at 42 months which is in the 55th percentile for his age yielding a language IQ of 102. The Preschool Language Scale (PLS) (Zimmerman, Steiner & Evatt, 1969) yielded a verbal age of 27 months, and his articulation age level from the Goldman-Fristoe Test of Articulation (Goldman & Fristoe, 1986) was 24 months. His receptive language on the Goldman-Fristoe was at 45 months. He was given a WPPSI-R at the onset of the study and received a Performance IQ of 118, a Verbal IQ of 116, and a full scale IQ of 120.

Luke was a 4-year-8-month caucasian boy from a middle-income home. He was enrolled due to speech and phonology delays. His records noted achievement of normal developmental milestones for walking (11.5 months) and first word (10 months), and testing at 42 months yielded age-appropriate scores in all areas except speech and phonology. On the PLS, he scored 31 months with only occasional two word utterances; and on the PPVT-R, he scored in the 22 percentile (low average). His articulation was below the 2.5 year range. He was given a WPPSI-R at the onset of the study, and received a Performance IQ of 76, a Verbal IQ of 79, and a full scale IQ of 75.

Megan was a 4-year-9-month caucasian girl from an upper-middle class home. She had initially presented with decreased use of her right hand and delayed speech. She suffered a stroke prenatally and had an area of encephalomalacia in the left middle cerebral artery. At 2 years of age, her receptive language was rated as "good" and expressive language as "poor." At 40 months, her language age as measured by the PPVT-R lagged by 12 months. She was given a WPPSI-R at the onset of the study and received a Performance IQ of 94, a Verbal IQ of 91, and a full scale IQ score of 91.

Initially, the students were placed in two groups for instruction. Emily, Matthew, and Kevin composed the triad; Luke and Megan composed the dyad. Each student was screened for the following skills: sitting at a table for 10 minutes or longer, following verbal directions, and making eye contact with the teacher; counting by rote to at least 6; counting 2- and 3-dimensional objects to at least 5; and performing an identity match for written numerals and for written number words. Luke and Megan (the dyad) could rote count to at least 6, count objects to 5, and match all the stimulus words and numerals to a sample. Emily, Matthew, and Kevin (the triad) could rote count to 14, count objects to 14, and match written words and numerals to samples. Also, all students were trained to wait for a prompt from the examiner before answering the question, and they were all verbally imitative.

Setting

The study occurred in a classroom for children with language delays and hearing impairments that contained 13 students and 2 teachers. A volunteer frequently was present. Two experimental sessions were conducted each day by a member of the research team (hereafter called the instructor). Instruction occurred in the classroom (7 x 11m) at either the activity or speech table (1 x 3m). The students sat facing the instructor with their backs to the classroom. The first session occurred during the morning activity time; and the second occurred immediately following lunch and prior to rest time. Students not involved in the study participated in regular classroom activities with one of the teachers or the classroom volunteer. Three individuals served as instructors; one for the first 8 of days of training, another for 3 days, and the third for the remainder of the study. This was necessary due to the resignation of a member of the research staff.

Materials

Two types of instructional materials were used during instruction: target stimuli and instructive feedback stimuli. For all children, the target stimuli were white cards (7 x 13cm) with coins (pennies, nickels, and dimes) taped on them. The instructive feedback stimuli also were white cards (7 x 13cm) but varied by group and condition. For the triad in the simultaneous condition, the instructive feedback stimuli were cards with pennies taped to them and with a number word written in lower case letters with a blue marker. For the triad in the alternating condition, the instructive feedback stimuli were cards with pennies taped to them and cards with a number word written in lower case letters in blue marker. For the dyad in the simultaneous condition, the instructive feedback stimuli were cards with the numeral and number word written in lower case letters in blue marker; for the alternating condition, the instructive feedback stimuli were cards with the numeral and cards with a number word written in lower case letters in blue marker. The target and instructive feedback stimuli are shown in Table 1. During instruction, children received marks on a tally sheet for correct responses. The sheets contained each child's name in large letters and circles equaling half the number of trials for each student. For each circle with two marks, the students were allowed to select an edible from an array of choices.

Insert Table 1 about here

Materials used during assessment of instructive feedback stimuli were separate white cards (7 x 13cm) with number words written on them, (triad and dyad), pennies taped to them (triad), and written numerals (dyad). For the matching task with the triad, a manilla strip (15 x 30cm), with three white cards affixed, was used. Coins were taped to the three cards in the following combinations: (a) the correct number of pennies; (b) the same number of coins as the target stimuli, but of different value; and (c) a combination that included some of the same coins as the target coin combinations.

Procedures

General procedures. Initially, all students were screened to identify unknown stimuli. The target stimuli were divided into two sets. Prior to instruction, two probe conditions were implemented. The first assessed students' performance on target behaviors and the second assessed their performance on instructive feedback stimuli. Instruction was then implemented in two separate daily sessions (counterbalanced for time of day), one with each set of target stimuli. With one set, two instructive feedback stimuli for each target behavior were presented on each trial; with the second set, two instructive feedback stimuli for each target behavior were presented separately on alternating trials. After criterion performance was established (3 consecutive days at 100% unprompted correct responses), instructive feedback probe sessions were implemented.

The triad was taught to name the values of coins (nickel) or coin combinations (nickel or dime and pennies). Their instructive feedback stimuli consisted of the written word for the value of the coin combinations and an array of pennies equal to the value of the combinations. They were instructed in a 1:3 arrangement until Emily reached criterion. The two remaining students remained together for one session and then were instructed individually. The instructor presented the group with 24 trials per session (4 trials x 2 stimuli for each child). For the individual sessions, each student received 8 trials (4 trials x 2 stimuli). Instruction was continued until each student reached criterion in both conditions.

The dyad were taught to recognize and to name expressively an array of pennies. Their instructive feedback stimuli were the numerals and the written number words corresponding to the coin combinations. The instructor delivered 16 trials per session (4 trials x 2 stimuli for each child). The stimuli differed for the two groups due to the differing initial abilities of counting, money, and coins.

Probe condition procedures. Prior to instruction, each student was tested to ensure that the stimuli to be taught were unknown. Three sessions were conducted over three days. In each session, the child was asked to state expressively the value of the coin combinations. The instructor presented an attentional cue ("Ready," or "Look," etc.), and, if the child responded affirmatively, the instructor said "How many cents?" and provided a 4-second response interval If the child responded correctly, the instructor praised the child. If a no response or error occurred, the instructor gave a nonjudgmental response such as "OK" or "We'll learn that later." A 2-5 second intertrial interval was used.

Instructive Feedback probe procedures. Instructive feedback probe sessions assessed children's acquisition of the instructive feedback stimuli. These sessions were conducted individually before the instructional condition and after children achieved criterion level performance. For the triad, three measures were collected over four sessions; these were (a) the percent of correct responding to an expressive number-word reading task (i.e., test of acquisition of the instructive feedback stimuli), (b) the percent of correct matching of the target coin combinations to the number of pennies in a 3-choice format (test of acquisition of the instructive feedback stimuli), and (c) percent of correct matching of the number word to the number of pennies in a 3-choice format (test of relationships between the two instructive feedback stimuli). For the number-word reading task, the instructor presented an attentional cue ("Look." or "Ready?"), ensured that the child looked, provided the task direction ("What's this?"), provided a 4-second response interval, praised correct responses, and ignored incorrect responses. For the matching tasks, the instructor placed the three-choice array in front of the child, provided an attention cue ("Look"), ensured that the child looked, gave the child a stimulus to match, and said, "Find the same." A 4-second response interval followed. Correct responses were praised and errors were ignored.

The students in the dyad were asked to expressively and receptively identify the instructive feedback stimuli (numerals and words corresponding to the value of the penny arrays). These sessions tested the acquisition of the instructive feedback stimuli. They also were asked to match arrays of pennies to the numerals and the written words (4-choice format). Each measure was assessed in four sessions. The procedures used were identical to those used with the triad.

Instructional procedures. A 4-second constant time delay procedure with instructive feedback was used. Constant time delay involves two types of trials: 0-second and delay trials. The 0-second trials involve presentation of the task direction followed immediately by a controlling prompt (i.e., one that ensures the child responds correctly). In this study, the instructor ensured that the student was attending, presented the card and the task direction ("How many cents?"), and immediately presented a verbal model of the correct response. The student then imitated the correct response. The instructor immediately showed a second card containing the instructive feedback stimuli and said, "This is also (number)." No response was required from the child and no consequence was attached to the instructive feedback. For each correct response to the target stimuli, the instructor praised the child, and marked a line on the reinforcer tally sheet. Children selected one edible for each of two marks on the tally sheet at the end of the session.

Starting with the second session, 4-second delay trials were used. These trials were identical to the 0-second trails with two exceptions. First, a 4-second response interval was inserted between the task direction and controlling prompt. Second, at the beginning of the session, the children were told to respond if they knew the answer but to wait if they did not. Consequences for correct responses were identical to those for the 0-second trials. If an error or no response occurred, the instructor modelled the correct response and allowed the child to imitate. The instructive feedback stimuli were presented following all responses. Five responses to the target stimuli were possible. The students could answer correctly before the prompt--unprompted corrects, answer correctly after the prompt--prompted corrects, answer incorrectly before the prompt--unprompted errors, answer incorrectly after the prompt--prompted errors, or give no response.

Experimental design

An adapted alternating treatments design was used (Sindelar, Rosenberg, & Wilson, 1985). It is a variation of the alternating treatments design in which treatments are applied to independent but equally difficult behaviors. Two sets of coin combinations (two per set) were assigned to each subject. Baseline probes determined that the sets were unknown. One set was taught using constant time delay and simultaneous presentation of the two instructive feedback stimuli on each trial, and the second set was taught using constant time delay and alternating presentation of the two instructive feedback stimuli for each target behavior. One session for each condition occurred each day counterbalanced for time of day.

Reliability

Interobserver agreement assessments occurred for the dependent measure, and procedural fidelity checks also were conducted (Billingsley, White, & Munson, 1980). The following behaviors were assessed for procedural fidelity: ensuring student attention, presenting the task direction, waiting the response interval, providing the model, delivering the instructive feedback, and waiting the intertrial interval.

Results

Reliability

During instructional sessions, interobserver agreement data were collected for 25% of the sessions for Kevin, 15% for Matthew, 9% for Emily, 19% for Megan, and 25% for Luke. Interobserver agreement data were collected in 47% of the initial probe sessions and 15% of the final probe sessions. Interobserver agreement percentages were calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100. In all initial probe sessions, the percentage of agreement was 100. The percentage of agreement during the simultaneous condition was 99.5 (range 98.2-100); for the alternating condition, the percentage was 98.9 (range 96.8-100). For the final probe sessions, the percent of agreement was 97.9 (range 83.3-100).

Procedural reliability was calculated by dividing the number of actual teacher behaviors in each category by the number of planned behaviors and multiplying by 100. The percentage of compliance with the procedures was 100 on all categories except waiting the correct number of seconds (97.9% in alternating condition for Kevin), giving the correct prompt (97.9% in alternating condition for Kevin), praising the correct response (87.5% in the alternating condition for Matthew), and presenting the instructive feedback (93.7% in the simultaneous condition for Matthew, 96.8% in the alternating condition for Luke, and 97.9% in the alternating condition for Megan).

Effectiveness

Triad. The constant time delay procedure was effective in teaching all three students to name values of coin combinations. Emily met criterion in 11 sessions for the simultaneous condition and in 9 sessions for the alternating condition. Matthew reached criterion in 20 sessions for the simultaneous and in 9 sessions for the alternating condition. Kevin reached criterion in 13 sessions for the simultaneous and in 23 sessions for the alternating condition.

Dyad. The students in the dyad were taught to state the value of arrays of pennies. Megan met criterion in 36 sessions for the simultaneous condition and 35 sessions for the alternating condition. She required several modifications during the study including additional training in waiting for the prompt, specific attentional cue that required her to match the stimulus card to a sample before responding, and differential reinforcement of unprompted and prompted correct responses. A touch cue was added but she abandoned it after the session in which it was modeled and began responding at a 100% correct level.

The constant time delay procedure was not effective in teaching Luke to name values of pennies to the pre-set criterion level. Luke's target task was to state the value of arrays of pennies (8, 9, 10, and 11). He displayed highly variable unprompted correct performance. When he was presented with only two stimuli in instruction, he would verbally rehearse and respond correctly more often when he saw the same stimuli repeated. He would respond before looking at the stimuli unless reminded both verbally and gesturally. He could not always remember the names of the edibles used for reinforcers and had to point to indicate what he wanted (M & M's and pretzels). Various procedural modifications were implemented throughout the investigation for Luke. These modifications included: (a) using a match-to-sample attending cue, (b) teaching individually instead of in the dyad, (c) delivering reinforcement only for correct unprompted responses and using trial-to-trial reinforcement, and (d) using two of the stimuli and teaching one stimulus for the simultaneous and one from the alternating condition in each daily session. These modifications resulted in increased correct responding and some sessions of 100% correct unprompted responding, but Luke did not achieve criterion. He was assessed during the last sessions of the school year to evaluate the acquisition of instructive feedback stimuli.

Efficiency

Efficiency measures included the number of sessions to criterion, number and percent of errors during training, and the percent of correct responding on the instructive feedback probe sessions. The number of instructional sessions through criterion are shown in Table 2. Substantial variability existed in the number of sessions required to achieve criterion in the two conditions. However, consistent differences in favor of either condition did not occur.

Insert Table 2 about here

The number and percentages of errors are shown in Table 3. They ranged from 6.7% to 29.1% for the four students who achieved criterion. Luke's errors ranged as high as 42.9%. The total percentages of errors for the Triad was 10.2%. The total for the Dyad was 28.2%.

Insert Table 3 about here

Performance on the instructive feedback stimuli for the triad was assessed by (a) expressive reading of the number words, (b) matching the coin combinations to the correct number of pennies (3-choice format), and (c) matching the written word to the correct number of pennies (3-choice format). The mean percent of correct responses on instructive feedback measures are shown in Table 4. For the triad, each acquired some of the instructive feedback stimuli. An analysis of differences for the three measures for the three students (9 comparisons) showed the simultaneous presentation resulted in higher percentages of correct responses in four instances, the alternating presentation resulted in higher percentages in four instances, and levels were equal in one instance.

Insert Table 4 about here

The percentages of correct responses by measure across students were compared. Matching the written word to pennies resulted in 68.75% correct responding compared to 47.91% for matching coin combinations to pennies and 37.5% for expressive identification of words. Higher levels of performance occurred on the tasks requiring a forced-choice format than expressive recall.

For the forced choice tasks for the triad, the highest level of response on the non-target probes was shown on the task that required the students to match one instructive feedback stimulus to the second instructive feedback stimulus. These percentages were greater than those for direct tests of acquisition on the instructive feedback stimuli.

The students in the dyad (Megan and Luke) were assessed on receptive and expressive identification of the instructive feedback stimuli and on matching the target stimuli to the numerals and written words (4-choice format). These measures were collected across four sessions. The data for Megan indicate that she learned to identify the numerals both receptively and expressively for both conditions, scoring at 100% on all numerals in the final three probes. She learned to read some of the words. Overall comparison of the means for simultaneous and alternating conditions indicates no systematic differences between the two conditions. She was able to match pennies (target) to words (87.5%) and to match pennies to numerals (100%). Luke did not achieve criterion level responding on the target behavior, but he was assessed on the instructive feedback stimuli. His responding during these probe sessions appeared random with the percent of correct responses below 50.

Discussion

The purpose of this study was to compare two methods of presenting multiple instructive feedback stimuli during direct instruction. The two methods involved presenting two instructive feedback stimuli for each target behavior on every trial and presenting the two stimuli for each behavior separately on alternating trials. From this study, four conclusions can be drawn. First, constant time delay and instructive feedback were effective with 4 of the 5 students. A recent review of the research with constant time delay and discrete tasks indicated that the procedure was effective with 97.7% of the subjects who had been taught with the procedure in 36 studies (Wolery, Holcombe, et al., 1992). Thus, Luke is one of the few cases where the procedure has not been effective. Several factors, separately or in combination, may have contributed to this lack of effectiveness. He had little experience with direct instruction, the task he was taught was difficult based on his entry level skills, he tended to respond quickly, and he tended to provide the same response despite stimulus changes across trials. Also, the presentation of two instructive feedback stimuli may have contributed to the procedure's lack of effectiveness for Luke. The other students each learned their target skills and some of the instructive feedback stimuli. The percentage of correct responding for these subjects on instructive feedback probe sessions was above chance levels for both instructive feedback presentation methods.

Second, the percent of errors displayed by all subjects was higher than typically reported when the constant time delay procedure was used with discrete responses and preschool children with disabilities (Wolery, Holcombe, et al., 1992). Possible explanations for this are the subjects' inexperience with direct instruction, the difficulty of the task, and the presentation of the multiple instructive feedback stimuli. Previous research has compared the rapidity of children's learning with and without instructive feedback (e.g., Holcombe-Ligon, Wolery, Werts, & Hrenkevich, 1992; Wolery, Doyle, et al., 1991). This research indicates that children learned more rapidly when one extra stimulus was provided in the feedback events. Future research should compare the effects of teaching three sets of stimuli sequentially rather than teaching one stimulus set while presenting two stimuli through instructive feedback.

Third, and most central to the purpose of this study, it appears that no consistent differences occurred between the two methods of presenting instructive feedback stimuli (i.e., simultaneous and alternating). The subjects who acquired their target behaviors performed similarly on the instructive feedback stimuli that were presented through the two methods. Two previous studies have used the simultaneous method of presenting two pieces of information (Gast et al., 1992; Harrell et al., 1992). In the Gast et al. study, two types of instructive feedback stimuli were presented and students learned one type to the exclusion of the other. When two stimuli of the type they had learned were presented through instructive feedback, they learned both equally and completely. In the Harrell et al. study, two types of stimuli also were presented, and both types were learned, but one was acquired at higher levels than the other. Megan's results are consistent with the Harrell et al. investigation; that is, she named the numerals at higher levels than she read the number words. This was not consistently the case with Emily, Kevin, and Matthew, possibly due to the fact that reading words and recognizing the value of arrays of pennies were of equal difficulty. Thus, it appears that the method of presentation had less effect than the type or difficulty of the stimuli.

Fourth, the subjects appeared to learn that the two stimuli presented during the feedback events were equivalent. The children in the triad were able to match the written number words with the number of pennies at percentages higher than chance (cf. Table 4). Interestingly, the amount of correct performance on this task was not related to the method of presentation. In the simultaneous presentation format, the two stimuli (i.e., number word and pennies) were presented on the same card. However, in the alternating presentation format, the two stimuli were not presented together, but were presented separately on alternating trials. This suggests that the acquisition of the target behavior may have mediated the acquisition of the equivalence of the two stimuli.

The implication of these findings for teachers is threefold. First, when two extra stimuli are presented through instructive feedback, students may acquire some of that information. Second, students may learn that the two instructive feedback stimuli are equivalent. Thus, using instructive feedback is recommended as is using multiple instructive feedback stimuli. Third, teachers can use either simultaneous or alternating presentation of the instructive feedback stimuli. However, these statements are made with several qualifications and limitations. The students in this study had mild disabilities, general intellectual functioning in the normal range (as measured by intelligence tests), relatively mild delays in the curricular area being studied, imitative abilities, the ability to perform identity matches on the stimuli used, and identified reinforcers. We expect the findings to be more likely replicated with subjects who display similar demographics and skills than those who do not. These subject characteristics are similar to the previous studies that investigated acquisition of two instructive feedback stimuli (Gast et al., 1992; Harrell et al., 1992). Despite this qualification, instructive feedback appears to be a robust procedure because it has been effective with preschoolers who have more substantial disabilities (Wolery et al., in press), and elementary (Gast et al., 1990; Wolery, Doyle, et al., 1991) and secondary students with moderate mental retardation (Doyle et al., 1990). Whether presentation of two stimuli through instructive feedback would be effective with these populations remains an issue for further investigation.

These preschool-aged children had IEP's in the areas of speech and language delays and one child had a mild to moderate hearing loss corrected with amplification. As such, their tested skills prior to the implementation of the procedures were fairly high on these numerical and quantitative tasks. Numerical tasks were selected to avoid areas that had been shown to be a deficit for any of the children, to provide a pool of tasks that were discrete in nature, and to teach in an area that the teacher reported was important and was on the children's IEPs but was not being addressed in the classroom at the time of the study.

In terms of future research, several issues deserve study. First, no study has investigated the extent to which presenting two stimuli for each behavior through instructive feedback interferes with the acquisition of the target stimuli. Previous research of adding one extra stimulus indicates that acquisition of the target stimulus is not negatively affected (Holcombe-Ligon et al., 1992; Wolery, Doyle, et al., 1991). However, the high error percentages in the present study indicate that presenting two stimuli for each target behavior through instructive feedback may interfere with the acquisition of target behaviors. Clearly, this issue deserves more study. Second, future research should address whether students learn higher levels of the instructive feedback stimuli when they are repeatedly taught and tested using this format. In the present study, the children learned one set of stimuli with simultaneous presentation and the other set with alternating presentation. It would be useful to know whether learning multiple sets with either presentation format would result in learning to learn two extra stimuli for each target stimulus. Third, the effects of intermittently testing students during instruction on their acquisition of stimuli presented through instructive feedback should be evaluated by future research. It is possible that such testing would cause more attention to, and thus more learning of, the instructive feedback stimuli. Finally, future research should investigate what types of extra stimuli are most readily learned when presented through instructive feedback. Some types of stimuli may be acquired more quickly than other types (Gast et al., 1992; Harrell et al., 1992).

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Table 1

Target and Instructive Feedback Stimuli

Student	Simultaneous		Alternating		
	Target[a]	Instructive Feedback	Target[a]	Instructive Feedback	
Triad					
Emily	D-P-P	"twelve"/12 pennies	N-P	"six"	6 pennies
	N	"five"/5 pennies	N-N	"ten"	10 pennies
Matthew	N	"five"/5 pennies	N-N	"ten"	10 pennies
	N-P-P-P	"eight"/8 pennies	N-P-P	"seven"	7 pennies
Kevin	N-P-P-P	"eight"/8 pennies	N-P-P	"seven"	7 pennies
	D-P	"eleven"/11 pennies	N-P-P-P-P	"nine"	9 pennies
Dyad					
Luke	9 pennies	"9"/"nine"	8 pennies	"8"	"eight"
	11 pennies	"11"/"eleven"	10 pennies	"10"	"ten"
Megan	9 pennies	"9"/"nine"	8 pennies	"8"	"eight"
	11 pennies	"11"/"eleven"	10 pennies	"10"	"ten"

[a] D = dime, P = penny, and N = nickel

Table 2

Number of Sessions of Training Through Criterion

Student	Simultaneous	Alternating
Emily	11	9
Matthew	18	11
Kevin	16	28
Megan	36	35
Luke[a]	(36)	(36)
Totals	117	119

[a] Luke did not reach criterion level responding.

Table 3

Number and Percentage of Errors During Training

Student	Simultaneous		Alternating		Total	
	Number	Percent	Number	Percent	Number	Percent
Emily	13	14.7	7	9.7	20	11.3
Matthew	18	11.8	24	15.8	42	13.8
Kevin	14	6.7	17	7.5	31	7.1
Totals	45	10.0	48	10.3	93	10.2
Megan	51	17.7	84	29.1	135	23.4
Luke[a]	(65)	(22.5)	(127)	(42.9)	(192)	(32.8)
Totals	116	20.1	211	36.1	327	28.2

[a] Luke did not reach criterion level responding.

Table 4

Percent of Correct Responding on Instructive Feedback Measures After Training

Measure (Purpose) Subject	Presentation of Method	
	Simultaneous	Alternating
Expressive Reading of Number Word (Test Acquisition of Instructive Feedback Stimuli)		
Emily	37.5	50.5
Kevin	0.0	75.0
Matthew	37.5	25.0
Megan	66.6	45.8
Matching Coin Combination to Number of Pennies (Test Acquisition of Instructive Feedback Stimuli)		
Emily	12.5	12.5
Kevin	50.0	37.5
Matthew	75.0	100.0
Matching Written Word to Number of Pennies (Test Existence of A Relationships Between Two Instructive Feedback Stimuli)		
Emily	62.5	50.0
Kevin	62.5	50.0
Matthew	87.5	100.0
Expressive Naming of Numerals (Test Acquisition of Instructive Feedback Stimuli)		
Megan	87.5	87.5

Appendix N

Constant Time Delay with Discrete Responses: A Review of Effectiveness and Demographic, Procedural, and Methodological Parameters

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Constant Time Delay With Discrete Responses: A Review of Effectiveness and Demographic, Procedural, and Methodological Parameters

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Constant time delay, a variation of progressive time delay, is a response prompting strategy designed to provide and remove prompts in a systematic manner on a time dimension. Constant time delay has two defining characteristics: (a) initial trials involve presentation of the target stimulus followed immediately by delivery of a controlling prompt; and (b) on all subsequent trials, the target stimulus is presented, a response interval of a fixed duration is delivered, the controlling prompt is provided, and a second response interval is delivered as needed. Reports of 36 studies using the constant time delay procedure with discrete behaviors were identified and analyzed. The results are described in terms of demographic variables (i.e., the types of subjects, set-

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tings, behaviors, instructors, and instructional arrangements), and the procedural parameters of the strategy. The effectiveness of the strategy and the outcome measures are summarized. Finally, the methodological adequacy of the constant time delay research is examined. Implications for practice and for further research are presented.

Since Touchette's (1971) use of delayed prompting to identify the moment in which stimulus control was transferred from a prompt to a target discriminative stimulus, numerous studies with the procedure have appeared. These studies used time delay to teach new behaviors rather than to identify the moment of transfer. Two variations of the procedure exist: progressive time delay and constant time delay (Snell & Gast, 1981).

Both time delay procedures use a controlling prompt and two types of trials: 0-second trials and delay trials. A controlling prompt is some form of assistance that consistently produces the target behavior (i.e., a stimulus that already has stimulus control of the response). The 0-second trials are used for the initial trial or block of trials and involve presentation of the target discriminative stimulus followed immediately (sometimes described as simultaneously) by delivery of the controlling prompt. Delay trials are used in all subsequent sessions and involve presentation of the target stimulus, delivery of a response interval (delay interval), provision of a controlling prompt, and delivery of a second response interval. With progressive time delay, the response interval is gradually and systematically increased over trials or blocks of trials. For example, the first trial may be delivered at the 0-second delay interval; the second at 1-second delay interval, the third at 2 seconds, and so on. This systematic increase in duration of the delay interval gives the procedure its name — "progressive" time delay. With constant time delay, the delay interval is increased for a specified and fixed number of seconds and remains at that duration throughout the instructional program, thus, the name "constant" time delay. For example, 0-second trials would be used for the initial trial or block of trials, and 3-second delay trials would be used for all subsequent trials.

Five responses are possible on delay trials. Correct responses before the prompt (correct anticipations), correct responses after the prompt (correct waits), error responses before the prompt (non-wait errors), error responses after the prompt (wait errors), and no responses (student does not respond after the prompt). If students do not respond after delivery of the target stimulus (i.e., during the delay interval), the prompt is presented at the scheduled time and another response interval is provided. Consequences are delivered as planned. If the student responds after the target stimulus and before the prompt, the prompt is not provided, but consequences are delivered. Over repeated trials, stimulus control is transferred from the prompt to the target stimulus.

The initial research focused on the progressive time delay procedure. Handen and Zane (1987) found 27 time delay studies, but only 7 used constant time delay. Subsequent to their review, several reports with the constant time delay procedure appeared. The purpose of this paper is to review and evaluate the constant time delay studies that taught discrete responses. In this paper, these investigations are analyzed on four dimensions (a) demographic variables (e.g., the subjects, behaviors, settings, instructors, and arrangements involved), (b) the procedural parameters (e.g., the number of 0-second trials, length of the delay interval, nature of attending and target cues, etc.), (c) the outcomes and outcome measures, and (d) the methodological adequacy of the research.

METHODS

The review progressed through three stages. First, reports using constant time delay were identified. This was done by reviewing all issues of the following journals since 1978: *American Journal on Mental Retardation* (formerly *American Journal on Mental Deficiency*), *Education and Training in Mental Retardation* (formerly *Education and Training of the Mentally Retarded*), *Education and Treatment of Children*, *Exceptional Children*, *Journal of Applied Behavior Analysis*, *Journal of the Association for Persons With Severe Handicaps* (formerly *Journal of the Association for the Severely Handicapped* and *American Association for the Education of the Severely and Profoundly Handicapped*), *Journal of Autism and Developmental Disorders*, *Journal of Early Intervention* (formerly *Journal of the Division for Early Childhood*), *Journal of Special Education*, *Mental Retardation*, and *Research in Developmental Disabilities* (formerly *Applied Research in Mental Retardation* and *Analysis and Intervention in Developmental Disabilities*). In addition, reference lists of reports using constant time delay and other documents describing the procedure were analyzed to identify relevant reports. All appropriate master degree theses and doctoral dissertations known to us were identified. Finally, members of our research group were given a list of the studies and asked to identify others.

Studies were included for review if they met two criteria. First, a constant time delay procedure was used; this was defined as having 0-second trials and delay trials for a fixed number of seconds. Articles were included if the purpose was to evaluate the constant time delay procedure and/or another issue (e.g., procedures for using small group instruction). Studies were excluded if two levels of delay trials were used. For example, if a study used 3-second delay trials and 5-second delay trials, it was not reviewed; such studies were considered progressive time delay investigations. The second criterion was that the behaviors taught were discrete responses rather than chained responses. Discrete responses were defined as behaviors that had a relatively short duration, were taught as a single unit, and did not involve a task analysis. Thus, studies of spelling behaviors were included, but studies teaching cooking, self-care, janitorial skills, etc. were excluded. A literature using the procedure with chained responses is emerging (McDonnell, 1987; Schuster, Gast, Wolery, & Guiltinan, 1988; Wolery, Ault, Gast, Doyle, & Griffen, 1990, 1991) but was not reviewed because such skills involve different procedural parameters.

Second, each study was described in terms of its demographic and procedural parameters. The outcomes of the studies, outcome measures, and the methodological adequacy of the research were described. The descriptions were then summarized.

Third, those descriptions were analyzed for consistency and for range of use/practice. We sought to answer questions such as: (a) What was taught, to whom, in what settings, and under what conditions? (b) how is the procedure used? (c) was the procedure effective in establishing acquisition, generalization, and maintenance? and (d) how technologically adequate is the research base with the procedure?

RESULTS

From the search, 36 constant time delay studies were identified. Ten studies were unpublished masters or doctoral theses; the remainder were published or in-press articles in professional journals. Seventeen studies were conducted to evaluate the effectiveness of the procedure; 8 compared constant time delay to another instructional procedure; 11 used the procedure but studied some other variable.

Demographic Variables

Demographic variables included the subjects, settings, instructors, instructional arrangements, and behaviors taught. Description of these variables are shown in Table 1.

In the 36 studies, 173 subjects were taught with the constant time delay procedure. Both genders were included; 73 subjects (42%) were male, and 51 subjects (29%) were female, but the gender of 49 subjects (28%) was not described in the literature. A broad age range of subjects was included. Preschoolers (3–5 years of age) constituted the largest group (77, 45%) followed by elementary-age students (6–11 years) (62, 36%) and adolescents (12–18 years) (32, 19%). Two subjects (1%) were 19 years of age or older.

Subjects were categorized by their primary handicapping condition as described in the respective reports (e.g., cerebral palsy). Subjects who were

TABLE 1
Demographic and Procedural Parameters of the Reviewed Literature

Reference	Subject[a]	Setting	Instructional Arrangement	Behaviors Taught	# Trials at 0 Second Per Behavior	# Seconds Delay Interval	Controlling Prompt
Alig-Cybriwsky, Wolery, & Gast (1990).	$n = 4$ 4–5 years Dev. Del.	preschool classroom	group	expressive word reading	4	3	verbal model
Ault, Gast, & Wolery (1988).	$n = 3$ 8–11 years Mod. MR	self-contained	1:1	expressive word reading	10	5	verbal model
Ault, Wolery, Gast, Doyle, & Eizenstat (1988).	$n = 3$ 8 years Autistic	self-contained	1:1	expressive numeral reading	9	4	verbal model
Bradley-Johnson, Sunderman, & Johnson (1983).	$n = 39$ 3–5 years 34 typical 5 limited English	preschool classroom	1:1	receptive letter discrimination	0 second during pretraining sessions	4	gestural model
Browder, Morris, & Snell (1981).	$n = 1$ 14 years Sev. MR	dorm room	1:1	manual signs	4	4	manual model
Chapman (1988).	$n = 6$ 3–5 years 3 Dev. Del.; 1 CP 1 Deaf; 1 typical	preschool classroom	1:1	expressive letter identification	10	3	verbal model

(Table continued on next page)

TABLE 1. Continued

Reference	Subject[a]	Setting	Instructional Arrangement	Behaviors Taught	# Trials at 0 Second Per Behavior	# Seconds Delay Interval	Controlling Prompt
Chiara (1990).	*n* = 8 3–4 years 5 typical; 2 CP; 1 Dev. Del.	preschool classroom	group 1:1	expressive photo identification	5	5	verbal model
Cybriwsky & Schuster (1988).	*n* = 1 10 years LBD	self-contained	1:1	multiplication facts	2	4	verbal model
Doyle, Gast, Wolery, Ault, & Farmer (1990).	*n* = 4 16–18 years 3 Mild MR 1 Mod. MR	self-contained	group	government agencies and medications	4	4	verbal model
Doyle, Wolery, Ault, Gast, & Wiley (1989).	*n* = 4 5 years 2 Dev. Del. 1 Hearing/Speech 1 Lang. Del.	preschool classroom	1:1	expressive word reading	5	4	verbal model
Doyle, Wolery, Gast, Ault, & Wiley (1990).	*n* = 3 4–6 years 1 Downs 2 Dev. Del.	preschool classroom	1:1	expressive word reading	5	4	verbal model
Edwards (1989).	*n* = 4 16–17 years 3 LD; 1 Mild MR	self-contained	1:1 computer	spelling of abbreviations	2	4	visual model
Gast, Ault, Wolery, Doyle, & Belanger (1988).	*n* = 4 8–13 years 1 Mild MR 3 Mod MR	self-contained	1:1	expressive word reading	10	4	verbal/ manual model
Gast, Dolye, Wolery, Ault, & Baklarz (1991).	*n* = 4 7–8 years 1 hearing 3 Mild MR	self-contained	group	expressive word reading	2	4	verbal model
Gast, Wolery, Morris, Doyle, & Meyer (1990).	*n* = 5 8–12 years 5 Mod. MR	self-contained	group	expressive word reading	3	4	verbal model
Johnson (1977).	*n* = 1 17 years ED, MR	sound attenuated booth	1:1	receptive identification	Wait training prior to instruction	4	gestural model
Keel & Gast (1992).	*n* = 3 11–12 years LD	resource room	group	expressive word reading	1	3	verbal model
Kinney, Stevens, & Schuster (1988).	*n* = 1 12 years LD	university office	1:1 computer	expressive spelling	6	6	visual model
Kleinert (1987).	*n* = 4 15–20 years Mod MR	self-contained	1:1	expressive word reading	3	5	verbal model
Kleinert & Gast (1982).	*n* = 1 31 years CP/Mod. MR	sheltered workshop	1:1	expressive manual sign	10	4	manual model

(Table continued on next page)

TABLE 1. Continued

Reference	Subject[a]	Setting	Instructional Arrangement	Behaviors Taught	# Trials at 0 Second Per Behavior	# Seconds Delay Interval	Controlling Prompt
Koury & Browder (1986).	*n* = 6 6–9 years TMH	room connected to primary classroom	1:1	expressive word reading	not given	5	verbal model
Kues (1988).	*n* = 4 4–5 years 1 CP; 3 Speech	preschool classroom	group	expressive letter/word reading	5	3	verbal model
Mattingly & Bott (1990).	*n* = 4 11–12 years 1 LD; 1 BD; 2 EMH	resource room	1:1	expressive multiplication facts	5	5	verbal model
Precious (1985).	*n* = 4 7–8 years LD	resource room	1:1	expressive word reading	2	3	verbal model
Schuster, Griffen, & Wolery (in press).	*n* = 4 10–13 years TMH	self-contained	1:1	expressive word reading	5	4	verbal model
Schuster, Stevens, & Doak (1990).	*n* = 3 10 years LD	resource room	1:1	expressive word definitions	6	5	verbal model
Stevens, Blackhurst, & Slaton (1991).	*n* = 5 11–12 years 3 LD; 2 Mild MR	resource room	1:1 computer	expressive spelling	5	5	visual model
Stevens & Schuster (1987).	*n* = 1 11 years LD	home & office	1:1	expressive spelling	2	5	visual model
Telescan (1990).	*n* = 6 10–12 years LD	resource room	1:1	expressive spelling	2	3	visual model
Thomas (1989).	*n* = 3 7–9 years LD	resource room	1:1	expressive word reading	6	3	verbal model
Wilbers & Wolery (1991).	*n* = 10 4–5 years 4 Dev. Del. 6 Typical	preschool classroom	1:1	expressive letter identification	5	5	verbal model
Winterling (1990).	*n* = 3 7 years LD	resource room	group	expressive word reading	5	3	verbal model
Wise (1990).	*n* = 4 13–15 years 3 LD; 1 EMH	resource room	group	expressive word reading	5	4	verbal model
Wolery, Ault, Gast, Doyle, & Mills (1990).	*n* = 4 7–8 years LD	resource room	group	expressive word reading	5	4	verbal model
Wolery, Cybriwsky, Gast, & Boyle-Gast (1991).	*n* = 4 14–15 years LD	resource room	group	content area facts	2	4	verbal model

(Table continued on next page)

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TABLE 1. Continued

Reference	Subject[a]	Setting	Instructional Arrangement	Behaviors Taught	# Trials at 0 Second Per Behavior	# Seconds Delay Interval	Controlling Prompt
Yancey (1987).	*n* = 5 10–11 years 3 Mild MR; 2 LD	resource room	1:1	expressive word reading	2	3	verbal model

[a] Dev. Del. = developmental delay; Mod. MR = moderate mental retardation; Sev. MR = severe mental retardation; CP = cerebral palsy; LBD = learning and behavior disorder; Mild MR = mild mental retardation; Lang. Del. = language delay; LD = learning disabled; ED = emotionally disturbed; TMH = trainable mentally handicapped; EMH = educable mentally handicapped.

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described only by an I.Q. score were grouped into one of three categories: I.Q. score of less than 35 was listed as severe mental retardation, 35–50 as moderate mental retardation, and 50–70 as mild mental retardation. Some of these subjects may have had Down syndrome, cerebral palsy, and/or other disabilities. A variety of diagnoses were represented, with learning disabilities (45, 26%) and moderate mental retardation (27, 16%) being the largest categories; 51 subjects (29%) were apparently free of disabling conditions.

The studies occurred in a variety of settings. The majority occurred in public school resource (12, 34%) or self-contained (10, 28%) classrooms. Studies also occurred in preschool programs (8, 20%), university offices (2, 6%), a sound attenuated booth (1, 3%), sheltered workshop (1, 3%), and dorm rooms (1, 3%).

Nearly all the studies involved adults delivering the instruction (31, 86%). Some of the adults were doctoral students (4, 11%), research or university-associated staff (4, 11%), and others were classroom teachers (20, 54%), some of whom were graduate students employed as classroom teachers and conducting their thesis research. Two studies (6%) used peers with disabilities as instructors; Koury and Browder (1986) used tutors with mild mental retardation, and Telescan (1990) used classmates with learning disabilities and behavior disorders. In three studies (8%), instruction was delivered through computers (Edwards, 1989; Kinney, Stevens, & Schuster, 1988; Stevens, Blackhurst, & Slaton, 1991).

The majority of studies (26, 72%) were conducted in 1:1 sessions. However, several studies (11, 31%) were conducted in small groups. For example, small groups of three (e.g., Winterling, 1990), four (e.g., Doyle, Gast, Wolery, Ault, & Farmer, 1990), and five (e.g., Gast, Wolery, Morris, Doyle, & Meyer, 1990) subjects were used. The studies with small groups involved preschool children (Alig-Cybriwsky, Wolery, & Gast, 1990) and older students (Gast et al., 1990). Nearly all studies involved massed trial sessions; however, two used trials spaced throughout a session or day. Chiara (1990) presented trials throughout the day with a minimum 15-minute intertrial interval. Chapman (1988) presented trials only when children initiated responses to the teacher during free play periods.

A variety of discrete behaviors were taught. The most frequently taught behaviors were sight words (18 studies, 49%), letter recognition (4, 9%), and spelling (5, 14%). However, behaviors such as addition, photograph naming, definition of words, stating social study facts, and many others were taught. Spelling was taught in each of the computer assisted instruction investigations.

Procedural Parameters

The procedural parameters of the reviewed studies also are described in the Table 1. The parameters included the use of (a) attending cues, (b) task directions, (c) number of 0-second trials, (d) length of the delay interval, (e) selection of controlling prompts, and (f) consequences for students' responses.

Attending cues and responses were used to ensure student attention prior to the delivery of instruction. In the studies, both general cues/responses (e.g., "Look."/looking at the target stimulus) and specific cues/responses (e.g., "Write the letters."/copying letters in a stimulus word) were used. General attending cues were used in the majority of the studies. Specific attending cues/responses included oral letter identification (e.g., Wolery, Ault, Gast, Doyle, & Mills, 1990), copying a written model (e.g., Keel & Gast, 1992), reading a math problem (e.g., Cybriwsky & Schuster, 1988), restating the task direction (e.g., Wolery, Cybriwsky, Gast, & Boyle-Gast, 1991), and matching the target stimuli (e.g., Doyle, Wolery, Ault, Gast, & Wiley, 1989).

Task directions were used to signal students to respond. A variety of task directions were used including "What word?" (e.g., Kues, 1988), "What is this?" (e.g., Browder, Morris, & Snell, 1981), and "Spell." (e.g., Stevens & Schuster, 1987). They were accompanied in most studies by the presence of a target stimulus (e.g., flash card). Task directions were given prior to sessions or before each trial. When presented only before sessions, the students tended to be of elementary age and have learning disabilities.

Zero-second trials provide students with assistance in performing target behaviors. They were used for the entire first session of instruction in 27 studies (75%). Of the remaining nine studies, Bradley-Johnson, Sunderman, and Johnson (1983) and Johnson (1977) used the 0-second delay trial only during wait training prior to instruction. Edwards (1989), Precious (1985), Stevens and Schuster (1987), and Telescan (1990) implemented 0-second trials for two trials per behavior. Browder et al. (1981) used 0-second trials, but it was impossible to determine how many were provided. Koury and Browder (1986) implemented "several trials at zero delay" (p. 253). When 0-second trials were used for an entire session, the subjects tended to be younger and/or more disabled.

Delay trials provide students with an opportunity to respond without assistance. The duration of the delay interval across studies ranged from 3 to 6 seconds. The most frequently used duration was 4 seconds; Kinney et al. (1988) was the only study that used a 6-second delay interval.

Controlling prompts provide students with the assistance needed to respond correctly. Nearly all studies used models of various forms. Verbal models were used frequently. A visual model of a word to be spelled (e.g., Stevens et al., 1991) and a manual model of the manual sign to be displayed (e.g., Kleinert & Gast, 1982) also served as controlling prompts.

Five responses are possible in the constant time delay procedure: correct anticipations, correct waits, nonwait errors, wait errors, and no responses. Consequences for these five responses varied greatly across reports. The majority of the studies used one consequence (i.e., reinforcer) for correct anticipations and correct waits and another consequence for wait errors and nonwait errors. Examples of consequences for correct responses included descriptive verbal praise, descriptive verbal praise and a token, descriptive verbal praise and a tangible, verbal praise, verbal praise and a token, and verbal praise and a tangible. Consequences for wait errors and nonwait errors included verbal feedback (e.g., "No." or "Wrong."), verbal feedback and in-seat time-out, verbal feedback and error correction, error correction, instruction to wait if the answer is not known, and ignoring. No responses were generally addressed in the same manner as the wait errors, although frequently the consequences for no responses were not specified.

Outcomes and Outcome Measures

The effectiveness of the constant time delay procedure and outcome measures used are displayed in Table 2. In 35 of the 36 studies, training was implemented until criterion level responding was established. The constant time delay procedure was effective with 97.7% of the subjects. The constant time delay procedure appeared to be ineffective for 4 of the 173 subjects.

Ault, Wolery, Gast, Doyle, and Eizenstat (1988) found that the procedure was ineffective with one of three students. The subject was an elementary-aged student with autism. Subjects in this study were taught to name numerals with a 4-second constant time delay procedure and a system of least prompts procedure. Instruction occurred in a 1:1 situation. Neither procedure resulted in criterion level responding, despite procedural modifications. As a result, a stimulus shaping program was designed and resulted in acquisition by this student.

Stevens et al. (1991) suggest that the procedure was not effective with one of, five of their subjects. The subject for whom the procedure was ineffective was a male, diagnosed as mildly handicapped and 11 to 12 years of age. In this study, subjects were taught spelling with a microcomputer using a 5-second constant time delay procedure. Six words were taugh during each experimental session with five trials per word. The total number of trials per session varied depending upon individual subject's performance. The subject with whom the procedure was ineffective was dropped from the study following training on the second word set due to the "exces

TABLE 2
Outcome Measures and Methodological Characteristics of the Reviewed Literature

Reference	% Subjects Effective	Procedural Modifications[c]	Maintenance	Generalization	Efficiency Measures Reported[d]	Design[e]	Dependent Measure Reliability[f]	Procedural Fidelity Reliability[f]
Alig-Cybriwsky, Wolery, & Gast (1990).	100	DR(+)	Thin R+ 1,3,5,7 weeks	material person person & setting	% ETC	MP	Y	Y
Ault, Gast, & Wolery (1988).	100	—	Thin R+ 1,3,5,7,9 weeks	person setting	STC #/% ETC MTC	PTD	Y	Y
Ault, Wolery, Gast, Doyle, & Eizenstat (1988).	66.6	—	Thin R+ review trials 1,3,5,7 weeks	material person person & setting	STC TTC % ETC	PTD MTC	Y	Y
Bradley-Johnson, Sunderman, & Johnson (1983).	—[a]	—	Review trials	—	Group mean % of errors	GR	Y	N
Browder, Morris, & Snell (1981).	100	—	Review trials 4 & 7 months	setting	% error per condition	MB	Y	Y
Chapman (1988).	83	—	Review trials	—	STC TTC % ETC	MP	Y	Y
Chiara (1990).	100	Wait Train (+)	1,3,5 weeks	material person setting	TTC #/% ETC	AATD	Y	Y
Cybriwsky & Schuster (1988).	100	—	Thin R+ review trials	material person setting	STC #/% ETC MTC	MP	Y	Y
Doyle, Gast, Wolery, Ault, & Farmer (1990).	100	—	Thin R+ review trials	—	TTC #/% ETC MTC	MP	Y	Y
Doyle, Wolery, Ault, Gast, & Wiley (1989).	100	Specific Attending Cue (+)	Thin R+ review trials	—	TTC % ETC MTC	MP	Y	Y
Doyle, Wolery, Gast, Ault, & Wiley (1990).	100	—	Thin R+ review trials 1,3,5 weeks	material person	TTC #/% ETC MTC	PTD	Y	Y
Edwards (1989).	100	—	Thin R+ 1,2,3 weeks	material person setting time/day	TTC STC #/% ETC MTC	MP	Y	Y
Gast, Ault, Wolery, Doyle, & Belanger (1988).	100	DR(+)	Thin R+ 1 week person & setting	material & setting;	STC % ETC MTC	PTD	Y	Y
Gast, Doyle, Wolery, Ault, & Baklarz (1991).	100	—	Thin R+ review trials	material	TTC #/% ETC MTC	MP	Y	Y
Gast, Wolery, Morris, Doyle, & Meyer (1990).	80	DR (+/-)	Thin R+	—	TTC #/% ETC MTC	MP	Y	Y

(Table continued on next page)

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TABLE 2. Continued

Reference	% Subjects Effective	Procedural Modifications[c]	Maintenance	Generalization	Efficiency Measures Reported[d]	Design[e]	Dependent Measure Reliability[f]	Procedural Fidelity Reliability[f]
Johnson (1977).	100	—	—	—	# Errors	DND	N	N
Keel & Gast (1992).	100	—	Thin R+	material & person	TTC STC % ETC	MP	Y	Y
Kinney, Stevens, & Schuster (1988).	100	—	1 & 4 weeks	material	TTC #/% ETC MTC	MP	Y	Y
Kleinert (1987).	100	—	Thin R+	material	TTC # ETC	PTD	Y	Y
Kleinert & Gast (1982).	100	Physical Guidance (+)	Thin R+ review trials	material	TTC % ETC MTC	MP	Y	Y
Koury & Browder (1986).	100	—	1 & 3 weeks	—	—	MP	Y	N
Kues (1988).	—[b]	DR+ Expanded Task Direction (+)	Thin R+	—	TTC #/% ETC	MP	Y	Y
Mattingly & Bott (1990).	100	—	Thin R+ 2,3,4 weeks	material	STC % ETC MTC	MP	Y	Y
Precious (1985).	100	—	Review trials	person & setting	TTC #/% ETC MTC	PTD	Y	Y
Schuster, Griffen, & Wolery (in press).	100	—	Review trials 2,4,8 weeks	material	STC #/% ETC MTC	PTD	Y	Y
Schuster, Stevens, & Doak (1990).	100	—	Thin R+ 6,10,14 weeks	read target word state word for definition	STC TTC #/% ETC MTC	MP	Y	Y
Stevens, Blackhurst, & Slaton (1991).	80	—	2 weeks	material persons	% ETC	MP	Y	Y
Stevens & Schuster (1987).	100	—	Thin R+	material person & setting	TTC # ETC MTC	MP	Y	Y
Telescan (1990).	100	—	1 & 2 weeks	tutoring skills to other behaviors	TTC STC #/% ETC MTC	MP	Y	Y
Thomas (1989).	100	—	Thin R+ review trials	material person setting	STC % ETC MTC	PTD	Y	Y
Wilbers & Wolery (1991).	100	DR (+)	Thin R+	—	STC TTC #/% ETC MTC	AATD	Y	Y

(Table continued on next page)

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TABLE 2. Continued

Reference	% Subjects Effective	Procedural Modifications[c]	Maintenance	Generalization	Efficiency Measures Reported[d]	Design[e]	Dependent Measure Reliability[f]	Procedural Fidelity Reliability[f]
Winterling (1990).	100	—	Thin R+	—	STC # ETC	MP	Y	Y
Wise (1990).	100	—	Thin R+	—	STC % ETC MTC	MP	Y	Y
Wolery, Ault, Gast, Doyle, & Mills (1990).	100	—	Thin R+	—	STC % ETC	MP	Y	Y
Wolery, Cybriwsky, Gast, & Boyle-Gast (1991).	100	DR (+)	Thin R+ Review trials	—	TTC % ETC	PTD	Y	Y
Yancey (1987).	100	—	Thin R+ 1 week	person & setting	MTC	MP	Y	Y

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[a] Subjects were trained for a specific number of trials rather than to criterion; therefore, judgements regarding effectiveness are not possible.

[b] Effective for two subjects and inconclusive for two subjects due to end of school year.

[c] DR = differential reinforcement of correct anticipations; a plus means the modification was effective and a minus means the modification was ineffective.

[d] STC = sessions to criterion; TTC = trials to criterion; ETC = errors to criterion; MTC = minutes of instruction to criterion.

[e] = MP = Multiple probe; PTD = Parallel treatment design; GR = Experimental group design; MB = Multiple baseline; AATD = Adapted alternating treatments design; D = Design not discernable.

[f] Y = data were collected; N = data were not collected.

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sive amount of time he required to meet the training criteria and the lack of generalization and maintenance that occurred following training" (p. 158). Although this subject did meet criterion during instruction of two word sets, the behaviors acquired did not maintain in the probe conditions.

Chapman (1988) suggests that the constant time delay procedure was ineffective with one of six subjects. The subject with whom the procedure was ineffective was a 4-year-old male who was deaf. This study used a modified incidental teaching procedure that included a 3-second constant time delay procedure to teach letter naming to preschoolers with handicaps. Differential reinforcement was introduced after six sessions following a decrease in correct anticipations. When this modification failed to bring the behavior to criterion, tracing the letter was introduced as a specific attending response in Session 20. Because this modification also was ineffective, an edible reinforcer was added for correct anticipations in Session 30. This modification was terminated due to a decrease in correct anticipations. Many of the errors involved the subject saying the correct letter but signing an incorrect letter; therefore, the instructor held the subject's hand while waiting for a response. Following this modification, the correct anticipations reached 90% and then declined. The next procedural modification was a 1:1 instructional arrangement using a 3-second constant time delay procedure in which the specific attentional cue was not used and only edible reinforcement was given. In three of seven sessions using this modification, the subject displayed 100% correct anticipations. Training was terminated at this point due to the end of the school year.

Gast et al. (1990) state that the procedure was ineffective with one of five subjects. The subject was a 9-year-old male with moderate mental retardation. Subjects in this study were taught to read environmental sight words using a 4-second constant time delay procedure in a group arrangement. Each subject had eight targeted words that were taught in sets of two. Several procedural modifications were implemented with this subject including a specific attentional response, thinned reinforcement for attending, teaching one word in isolation, 1:1 as well as the group sessions, and reassigning words to new pairs. The final modification was effective in teaching the subject to respond correctly to two behaviors (pull/exit). The authors suggest that the similarity of the initial word pair (push/pull) may have contributed to the procedure's ineffectiveness.

Procedural modifications were necessary to ensure effectiveness in some studies. Modifications included the implementation of differential reinforcement (e.g., Wolery et al., 1990), the addition of specific attention cues (e.g., Doyle, Wolery, Gast, Ault, & Wiley, 1990), wait training (e.g., Chiara, 1990), and expanded task directions (e.g., Kues, 1988). Differential reinforcement (i.e., reinforcement of correct anticipations rather than correct anticipations and correct waits) was used when students displayed high percentages of correct waits and low percentages of correct anticipations. This contingency change was effective in establishing high levels of correct anticipations 83% of the times it was used. Specific attending cues (e.g., saying the names of the letter for the target word) were used when students displayed nonwait errors and correct waits but not correct anticipations. This was effective in establishing high percentages of correct anticipations. Specific attending cues appear to call students' attention to the critical dimensions of the target stimuli. Wait training was used when students displayed high percentages of nonwait errors. It involved teaching students to wait for teacher assistance, and was effective in increasing the proportion of correct wait responses (Snell & Gast, 1981).

A variety of measures frequently used as indices of efficiency were reported in the literature. Many of the studies reported sessions (46%), trials (54%), percentage/number of errors (91%), and minutes of direct instructional time (60%) to criterion. Error percentages, when reported, consistently were less than 4% for subjects with mild handicaps and 8% for those with more involved learning problems. In some cases, errors were as high as 12%; however, in several other studies, errors were less than 1%.

Transfer of stimulus control (i.e., the point at which the percentage of correct anticipations exceeded the percentage of other responses) for individual subjects ranged from 1 to 12 sessions. In nearly all studies, however, transfer occurred by the fourth session. More precise figures about the normative efficiency of the procedure are impossible to discern because (a) subjects' abilities differed within and across studies, (b) the number and difficulty of the behaviors taught varied across studies, (c) data were averaged for all subjects in some reports, and (d) only probe data were presented in other reports.

Generalization measures were collected in 22 studies and included generalization across materials (e.g., Ault, Wolery, Gast, Doyle, & Eizenstat, 1988), persons (e.g., Cybriwsky & Schuster, 1988), settings (e.g., Chiara, 1990), persons and materials (e.g., Keel & Gast, 1992), persons and settings (e.g., Alig-Cybriwsky et al., 1990), and materials and settings (e.g., Gast, Ault, Wolery, Doyle, & Belanger, 1988). In the majority of studies where generalization was measured, it occurred at some level.

Maintenance was programmed through review trials and the thinning of reinforcement during instruction from a CRF to a VR3 schedule. Follow-up maintenance checks were conducted at varying intervals following instruction (e.g., 1, 3, 5, 7, and 9 weeks by Ault, Gast, & Wolery, 1988). In most, but not all cases, acquired behaviors maintained.

Constant time delay was compared to other procedures in eight studies. In three studies (Ault et al., 1988; Doyle et al., 1990; Gast et al., 1988), constant time delay was compared to the system of least prompts and produced more rapid learning and fewer errors. Three other studies compared constant to progressive time delay. Precious (1985) found minimal differences between the two procedures; Thomas (1989) found mixed individual results, but overall progressive time delay resulted in fewer errors, less instructional time, and fewer sessions to criterion; Ault et al. (1988) found constant time delay to be more efficient across three subjects although differences were slight for two. Constant time delay also was compared to a simultaneous prompting procedure (Schuster, Griffen, & Wolery, in press). The simultaneous prompting procedure was similar to constant time delay in that only 0-second trials were presented during instructional sessions (the prompt was not faded across the time dimension). In this study, simultaneous trial presentation was found to be slightly more efficient in terms of instructional time, percent of errors, and sessions to criterion. The final study (Bradley-Johnson et al., 1983) compared constant time delay to stimulus fading; constant time delay was judged to be more efficient.

Methodological Adequacy

The studies using constant time delay were analyzed across three methodological parameters: (a) adequacy of the experimental designs, (b) extent to which interobserver agreement data were collected on the dependent measures and the results of that measurement, and (c) extent to which procedural fidelity data were collected (i.e., evidence that important experimental variables including the independent variable were implemented as planned) and the results of that assessment.

The research evaluating constant time delay used adequate experimental designs in 35 of the 36 studies. Single subject experimental designs were used in all investigations except one. The multiple probe design was used most frequently (22, 61%) followed by the parallel treatments design (9, 25%). Sufficient replications and control existed in 35 of the 36 studies to conclude that experimental control was established.

Interobserver agreement data were collected on the dependent variable in 35 of the 36 studies. This measurement almost always occurred in at least 20% of the experimental sessions. The percentages of interobserver agreement were consistently above 90 and frequently greater than 95. In most cases, interobserver agreement percentages were calculated by dividing the number of agreements by the number agreements plus disagreements and multiplying by 100.

In 33 of the 36 reports, data were included to document that experimental variables were implemented as planned; this measurement frequently occurred on at least 20% of the experimental sessions. The investigators measured whether control variables (e.g., standard presentation of target stimuli, application of consequences) were implemented as planned across experimental conditions (e.g., probe and instructional conditions) and whether the independent variable (e.g., constant time delay) was implemented as planned. Some studies reported percentages of fidelity for each subject and each procedural variable, others reported percentages for each condition summed across subjects, and others reported a single percentage for all subjects and procedural variables. For all studies measuring procedural fidelity and using human instructors (i.e., computer-assisted studies were excluded), a mean percent of correct implementation was computed across all subjects and procedural variables. This analysis indicated a mean percent of correct implementation of 99.5 (range, 98.0–100 across studies). Procedural errors occurred most frequently on the use of the correct delay interval; however, the percent of correct implementation was consistently above 95%.

DISCUSSION

The purpose of this review was to describe the effectiveness and the demographic, procedural, and methodological parameters of the research using the constant time delay procedure with discrete behaviors. A summary of the findings is included in Table 3. Taken as a whole, the constant time delay procedure (implemented in the described forms) was effective in teaching discrete behaviors to a variety of students; in a number of settings; with different instructional arrangements, formats, and agents. This instruction resulted in relatively rapid learning (e.g., transfer of stimulus control occurred by the third or fourth session) and low error percentages. The research indicates that the procedure was at least as efficient as progressive time delay, more efficient than the system of least prompts, and more efficient than a stimulus fading procedure; however, it was less efficient than the simultaneous prompting procedure. Further, the research base was methodologically sound. Thus, it appears that the procedure may be a viable direct-instruction strategy in many contexts. However, some caution is needed. Most of the subjects in these studies appeared to be imitative, were under instructional control, would wait for teacher assistance, and had identified reinforcers. Whether the obtained results would be found with subjects who did not display these characteristics is open to further investigation.

The review also identified areas where additional research is relevant. First, no investigations were identified that studied procedural parameters of the strategy. The exception may be the Schuster et al. (in press) study comparing simultaneous trial presentation and constant time delay. With the simultaneous prompting procedure, all instructional trials were 0-sec-

TABLE 3
Conclusions About Constant Time Delay in Teaching Discrete Behaviors

1. Constant time delay was effective with students who did and did not have handicaps and who ranged in age from 3 to 31 years. The students were imitative, under instructional control, had identified reinforcers, and displayed waiting responses.

2. Constant time delay was effective in massed-trial sessions (in 1:1 and small group arrangements) and when trials were distributed throughout an activity or day.

3. Constant time delay was effectively delivered by adults, peers with disabilities, and computers.

4. Zero-second trials were most frequently implemented for an entire session, 3- and 4-second delay trials were most common, and models of various forms were always the controlling prompts.

5. Consequent events for correct anticipations and waits were frequently the same and involved a variety of forms of praise and frequently tokens and/or tangible reinforcers; consequent events for nonwait and wait errors were frequently the same and involved verbal feedback that an error occurred, error correction, and instructions to wait.

6. When students did not readily learn, effective modifications were (a) wait training when correct anticipations and correct waits were at low percentages, (b) reinforcement for correct anticipations only rather than for correct anticipations and waits when waits occurred at high percentages and anticipations occurred at low percentages, and (c) specific attentional cues/responses when subjects displayed high percentages of correct waits and nonwait errors.

7. When efficiency is measured in terms of the number of sessions, trials, errors (percent of errors), and minutes of instructional time to criterion, constant time delay is (a) as efficient as progressive time delay although individual differences exist, (b) more efficient than the system of least prompts and a stimulus fading procedure, and (c) less efficient than simultaneous prompting procedure.

8. Sound methodology was used in the research as evidenced by (a) adequate experimental designs being used in 97% of the studies, (b) interobserver agreement data being collected on dependent measures in 97% of the studies with agreement scores exceeding 90%, and (c) procedural fidelity data being collected in 88.8% of the studies with estimates above 98.0% when percentages were averaged across subjects and variables.

ond trials. The dependent measure was collected from daily probe sessions. The subjects in this study had experience with time delay instruction; thus, they may have previously learned to learn from 0-second trials. Other research with the simultaneous prompting procedure (Wolery, Fleming, Venn, Domjancic, & Thornton, 1991) suggest that the daily probes may be a functional variable with this procedure. In the reviewed constant time delay studies, a few students appeared to become prompt dependent; that is, they performed correct-wait responses at high percentages and little transfer to the target stimulus was evident. This was frequently corrected by reinforcing only correct anticipations rather than correct anticipation and wait responses. This prompt dependence may be problematic with the simultaneous prompting procedure. Thus, the relative superiority of the simultaneous prompting strategy over the constant time delay procedure awaits further study, particularly with students who do not have a history with either procedure.

Other parametric studies also may be useful. For example, comparison of one session of 0-second trials versus one or two 0-second trials per behavior would help identify the role of repeated 0-second trials in learning. Another area of further research is the use of controlling prompts other than models. While physical prompts with the constant time delay procedure have been effective in teaching chained tasks (Gast, Winterling, Wolery, & Farmer, in press), the use of physical prompts with discrete tasks has not been demonstrated with constant time delay. Such demonstration is necessary before the procedure can be recommended for teaching children who do not imitate. Further, evaluation of different contingencies for each of the five possible responses merits study.

In the reviewed literature, the constant time delay procedure was delivered by trained adults, peers, and through computer-assisted instruction. While the initial results with peers as tutors and with computer-assisted instruction are promising, more research is needed. In the Koury and Browder (1986) investigation, students with mental retardation were taught to use the procedure to teach their peers. However, the teacher sat between two tutors and monitored and prompted (if necessary) their use of the procedure. Thus, the tutors were not entirely independent. In the Telescan (1990) study, the tutors were more independent, and generalization was assessed across their ability to teach other behaviors. This study constitutes a model for other investigations of peer tutoring. No studies were found where typical students taught children with handicaps using the constant time delay procedure. Such studies are needed given the near errorless results with teacher-delivered constant time delay and the potential benefits for positive interactions when typical peers teach children with handicaps.

The investigations with computer-assisted instruction all taught spelling. Several questions remain about the viability of computer-assisted instruction with the constant time delay procedure. These include whether a variety of skills can be programmed using the constant time delay procedure, whether such programming will result in learning, how well computers can be programmed to deliver controlling prompts, and whether reinforcers external to the computer may increase its effectiveness and efficiency. In teacher-delivered instruction, stimulus shaping and fading are generally superior to response prompting strategies; however, they require considerable material preparation time (Ault, Wolery, Doyle, & Gast, 1989). The use of micro-computers may substantially reduce the material preparation time; thus, stimulus shaping and fading programs may become more viable instructional options. Research is needed that compares the effects of computer-assisted constant time delay with refined computer-assisted stimulus shaping and fading programs.

Before constant time delay can be recommended to teachers without reservation, information is needed on the consistency with which the procedure must be implemented. In the reviewed reports, the constant time delay procedure was implemented with at least 98% compliance with procedural specifications (i.e., mean across subjects and variables). In many cases, the strategy was implemented with few identified procedural errors. These findings represent a high degree of correct implementation; despite the procedure's simplicity, this may not be likely in usual practice. Thus, two lines of inquiry are important: (a) the extent to which teachers will use the procedure correctly during usual instruction, and (b) the extent to which students will learn when the procedure is not implemented with high procedural fidelity.

Although classroom teachers implemented the instructional sessions in many of the studies, no data were found describing their use of the procedure when they were not participating in a monitored investigation. One study, however, evaluated the effect of procedural errors on students' learning (Wilbers & Wolery, 1991). Two conditions were compared in this study: (a) constant time delay with high procedural fidelity on all variables, and (b) constant time delay with high procedural fidelity on all variables except the duration of the delay interval on delay trials. Students learned in both conditions, but the percent of errors was higher for some subjects when the duration of the delay interval was inconsistently implemented. Whether similar results would be found if multiple variables were implemented inconsistently or inaccurately and when the 0-second trials were implemented erroneously is open to further inquiry.

In summary, the constant time delay procedure appears to be a viable strategy for teaching a range of students many different discrete responses. The qualifications, of course, are that the students should display the common prerequisite behaviors (imitation, identified reinforcers, instructional control, etc.), and the procedure should be implemented with a high degree of accuracy and consistency. A considerable amount of additional research is needed to understand fully the procedure's effects. This research should focus on at least four areas (a) evaluations of the constant time delay with additional populations (e.g., students who are not under instructional control, students with visual impairments), (b) analyses of the procedural parameters of the strategy (e.g., the number of 0-second trials needed, various contingencies), (c) applications of the procedure by different treatment agents (e.g., typical peers and computers), and (d) investigations addressing the extent to which teachers use the procedure accurately and consistently and the effects of that use on students' learning.

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Appendix O

Instructive Feedback: Increasing Opportunities for Additional Learning

Instructive Feedback: Increasing Opportunities for Additional Learning

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Abstract

Studies in the effectiveness and efficiency of instructive feedback, the addition of information in the praise statement after instructional trials, are reviewed. Instructive feedback behaviors can be parallel to the target behaviors, an expansion of the target behaviors, or they can be novel material. Examples from the research indicate a diversity of both target and instructive feedback stimuli and a variety of presentation methods that have been effective. Guidelines for the selection of skills to be taught, methods of presentation, and monitoring of student performance are given along with an example of the model in practice.

Instructive Feedback: Increasing Opportunities for Additional Learning

Direct instruction is an effective and efficient mode of teaching, but students learn many useful skills and behaviors incidentally. Examples are easy to pinpoint. In home economics class, students are taught how to heat the pan, crack an egg into it, and fry the egg. They learn incidentally that a high level of heat will result in more rapid cooking, and that the outside of the egg turns white when it is done. In math classes, students learn how to use a solar calculator: to enter the correct digits and to press enter to read the answer. They may learn, on a second level, that a brighter light source results in a brighter display and that covering the solar cells causes the display to fade. Elementary students may be taught to count the change for a dollar, and, in addition to learning the values of the coins, they may learn that change weighs more than bills, and that coins are round and that they have pictures of people on them. This extra information is available to students continually, and the instructor who plans systematically for it may increase the level of learning for some students.

A procedure that can be added to almost any direct instructional strategy to promote this incidental or extra learning is called instructive feedback (Werts, Wolery, & Holcombe, 1991). The procedure is easy to implement, relatively quick to deliver, and, in short, is an efficient way to facilitate the learning of additional information and to teach on two levels concurrently. This procedure involves presenting selected extra information in the events that follow student responding.

Simply stated, the teacher presents a task for the student to learn, and then, after a response, the teacher delivers praise and adds information that is related to the answer. For example, Mrs. Piper wants John to learn to read vocabulary words from the basal reader. She uses a direct instruction procedure and reinforces him with verbal praise after each correct trial. A trial would sound like this:

Mrs. P.: "John, look. What's this word?"
John: "Lute."
Mrs. P.: "Good."
With instructive feedback, Mrs. Piper modifies her response only slightly:
Mrs. P.: "John, look. What's this word?"
John: "Lute."
Mrs. P.: "Good. It's a stringed instrument."

Therefore, with some planning, but minimal investment of instructional time, the teacher has taught two concepts, sight word reading and definitions, rather than one. John is not expected to respond to the definition, nor is he reinforced for learning the definition but a growing body of literature shows that students of many ages and with different disabilities can learn extra information if teachers consistently plan for and add that information after the learning trial (Werts, Wolery, Holcombe-Ligon, & Frederick, 1992; Wolery, Cybriwsky, Gast, & Boyle-Gast, 1991; Wolery, Holcombe, Werts, & Cipolloni, in press.)

Getting Started

As in any teaching situation, the instructor must make several decisions before beginning instruction. These decisions include the format for teaching (e.g., individual or small group instruction, etc.), when instruction should take place, and what instructional methods to use. The factors that influence many of these decisions and guidelines for making these decisions are beyond the scope of this article. However, in considering a choice of strategies, teachers are encouraged to select the ones that are appropriate for the student and that maximize instructional time (Wolery, Ault, & Doyle, 1992).

Selecting the Target Information

In planning for teaching on two levels--direct instruction and instructive feedback--the first step is to identify the target skills to be taught. The selected skill should meet several criteria. Teachers should select skills that are appropriate, that students need to function more competently in the current and future environments, and that are consistent with students' IEP goals or the curriculum standards of their school district. Ideally, the materials should be interesting and motivating to the child.

Selecting the Instructive Feedback Information

The next step is to select the "extra" information to be included. Not surprisingly, the selection of the extra material should be undertaken with as much care as the selection of the target behaviors. Three categories of instructive feedback stimuli are possible: (a) those that are parallel to the target, (b) those that are an expansion of the target, and (c) those that are novel. Examples are shown in Table 1.

Insert Table 1 about here

Parallel instructive feedback behaviors are those that have the same answer or characteristics as the target. Many of these have been used in the research: Arabic and Roman numerals and sets of objects (Holcombe-Ligon, Wolery, Werts, & Hrenkevich, 1992); numbers and number words (Holcombe, Wolery, Werts, & Hrenkevich, 1991); coins and number words (Wolery, Werts, Holcombe, Billings & Vassilaros, in press); fractions and percentages (Werts, Wolery, Holcombe-Ligon, & Neumont-Ament, 1992). The students in these projects learned the target information or learned to recognize or label the target stimuli, and they learned that another stimulus has the same label.

Expansion instructive feedback behaviors are those that extend the concept presented in the target teaching. Several studies taught students to read sight words and then extended the concept to add the definition of the word (Stinson, Gast, Wolery, & Collins, 1991; Shelton, Gast, Wolery & Winterling, 1990; Gast, Wolery, Morris, Doyle, & Meyer, 1990). One study (Gast, Doyle, Wolery, Ault, & Baklarz, 1991a) added the spelling of the word to expand the information taught. Others (Wolery, Cybriwsky, Gast, & Boyle-Gast, 1991; Gast, Doyle, Wolery, Ault, & Baklarz, 1991b) taught additional social studies facts. In each case, the target behavior was different from but related to the instructive feedback stimulus.

The third category, novel material, is that which has little to do with the target behavior. Werts, Wolery, Holcombe-Ligon, Vassilaros and Billings (in press) taught preschoolers to name the shape when shown a colored stimulus. They then added the name of the color as instructive feedback. Werts, Wolery, Holcombe-Ligon, and Frederick (1992) compared acquisition of material that was related to material that was unrelated to the target behaviors. They found that students could learn the unrelated material and that it appeared to be more important to consider student interest and difficulty level than a direct academic relationship when selecting instructive feedback stimuli.

Presentation Methods

Obviously, decisions regarding method of presentation for both the target and instructive feedback stimuli must consider student characteristics as well as characteristics of the stimuli. Student's acuities and sensory abilities are critical. For example manual signing or total communication may be most appropriate with students who have hearing impairments. Students with visual impairments may need tactile stimuli or cards with large bold type. Material and information also dictate some decisions regarding presentation. Identification of colors requires a visual presentation. Identification of coins may be visual or tactile. Facts, word recognition, or numbers could be presented verbally or with a combination of modalities. These decisions need to be considered carefully for each situation.

In the literature, stimuli have been presented verbally (Doyle, Gast, Wolery, Ault, & Farmer, 1990), signed manually (Werts, Wolery, Holcombe-Ligon, Vassilaros, & Billings, in press), printed on flash cards (Gast, Doyle, Wolery, Ault, & Baklarz, 1991a), flashed on a computer screen (Edwards, 1989), depicted in photographs (Gast, Doyle, Wolery, Ault, & Baklarz, 1991b), or shown through line drawings (Werts, Wolery, Holcombe-Ligon, & Frederick, 1992). One study showed a printed word that the student was learning to read, and for instructive feedback, the teacher recited each letter of the word aloud to teach spelling (Gast et al., 1991). Although a variety of means for presenting both target and instructive feedback stimuli have been evaluated, systematic comparison of presentation modes has not been attempted. The teacher must consider the individual needs of the students and the characteristics of the material to be taught in making these decisions.

Several studies have presented the instructive feedback information on every trial where the student responded correctly. Others have interspersed the trials with added instructive feedback with those looking at other variables. Although we cannot directly compare the amount of learning, it is instructive to note that incidental information does not seem to interfere with learning target material. In fact, Janssen and Guess (1978) found that modelling the function of an object after correct pointing to the correct object allowed individuals with severe intellectual disabilities to acquire labeling skills faster than the training alone.

Several studies have explored the amount of material that may be added through instructive feedback. Wolery, Werts, Holcombe, Billings, and Vassilaros (in press) added two types of information for each target behavior: one condition added two types simultaneously (two pieces of information on one flash card after every trial) and one condition added two types but presented each one every other trial. There was no substantial difference in the amount of information learned between the two presentation methods. In a study by Gast, Doyle, Wolery, Ault and Baklarz (1992), students were given two types of information after learning to label photos of buildings in the local community. Through instructive feedback, they were told (a) the name of the street on which the building was located, and (b) the activity that occurred in the building. When the instructive feedback information consisted only of the street name, the students learned to name all the streets. When they were told both the street name and the activity, they learned the activity that occurred in the building but not the street name. When they were told two activities, they learned both of them. Labeling the activity was probably "easier" (perhaps because students had a referent for the activities) or of more interest to the students than the street names. Harrell, Wolery, Ault, DeMers, and Smith (1991) directly taught antonyms and added the sight word and a definition as the consequent event. The students learned to read the words at high percentages (over 80% correct responding) and 3 of the 7 students also learned to respond correctly with the definitions of the words (two of them at 100% correct responding). It was hypothesized that the number or amount of extra information learned may be a function of the difficulty of the material instead of whether one or two pieces are presented. The research literature does not indicate whether more than two pieces or types of extra information can be learned.

Monitoring

Monitoring is a basic component of high quality direct instruction. It is critical for a teacher to know when the students have learned the material. A number of different data collection systems exist for monitoring learning (Wolery et al. 1992; Wolery, Bailey, & Sugai, 1988). The method used may vary depending on the instructional strategy used but the critical factor is that the learning be monitored. Instructive feedback behaviors are not always learned to 100% acquisition (Werts, Wolery, & Holcombe, 1991). Therefore, it is imperative that the teacher know how much learning has taken place so that future instruction (either directly or through instructive feedback) can teach what is needed, rather than what is already known.

Future Instruction

Several studies have focused on the acquisition of material that has been introduced through instructive feedback, but which was not learned at 100%, and then taught as target behaviors in later sessions. Results indicate that the material that is introduced through instructive feedback (although not always completely mastered), does not interfere with the acquisition of the target behaviors (Wolery, Doyle, Ault, Gast, Meyer, & Stinson, 1991), and when it is taught directly at a later time, it is then acquired at a faster rate than similar material not presented as instructive feedback (Holcombe-Ligon, Wolery, Werts, Hrenkevich, 1992; Holcombe et al., 1992).

Instructive Feedback in Practice

The following example shows how the procedure has been implemented in a small group during the day in a special education classroom (Wolery, Cybriwsky, et al., 1991). The technique has also been successfully implemented on a individual basis and has been shown to be effective with students of various ages and handicapping conditions.

Kathy taught in an special education resource room in a public high school. She had several students who were learning facts related to social service agencies, over the counter medications and effects of specific vitamins and minerals on the body. She taught these students each day in a small group using a direct instructional technique called constant time delay. She used a visual and verbal presentation to ask the specific questions of each of the students and presented a "controlling prompt" that ensured that each student answered correctly (a verbal model delivered 4 seconds after the presentation of the stimulus that the students could imitate). Kathy decided to increase the efficiency of her teaching by adding additional facts to the praise statements following each answer given by the students. The extra facts were added only after the correct responses by the students. These answers were verbally and materially rewarded and then the additional facts were inserted. Since constant time delay is a near errorless technique, presentation of the additional information was expected to occur on almost every trial but Kathy anticipated that it would only add a few seconds to the session as a whole. Each of the four students in the group were asked to respond four times to each target fact, giving a session of 64 trials (4 problems x 4 presentations to each student x 4 students). Each session would typically take 8 to 11 minutes.

Kathy taught the sessions at a table in the back of the classroom while the other students in the class were engaged in independent seatwork. Each question for the fact to be learned was printed on the front of a large card and the back of the card contained the correct response, and the extra information that Kathy wanted to add following correct responses. Kathy held up the cards one at a time, called on one student, waited for the student to look, and she read the fact question: (e.g., "Tom, where do you get your driver's license?"). Tom responded, "The county clerk's office." The praise was given: "Good." or "That's right." Then Kathy inserted the additional fact: "And you can get a boat license there, too." Notice that Tom did not respond to this additional information--it was just presented.

Monitoring was ongoing while the sessions were taking place. She recorded the number of times each student correctly waited for the prompt and the number of correct answers given before the prompt. Graphs were kept for each student's performance and reinforcers were given following the sessions.

The group's criterion level of responding was set at three days of 100% correct responding. When all four students reached this level, Kathy tested them individually on their knowledge of the facts they were taught directly and on the facts inserted in the praise statements. Each of the four students learned the facts that were directly taught. Kathy had continued to teach until each student was responding to his or her fact questions with 100% accuracy for several days, and so the individual tests confirmed that they were able to answer the questions without direct reinforcement for each response. She then tested to determine whether they had learned any of the facts that were added. The students had never been reinforced for nor had they been asked to respond in any way to the additional information. The group obtained a mean of 82.1% correct responses on information presented in the feedback statements without purposeful training or contingencies.

Kathy could have made other choices about her procedures which may have made the procedure even more efficient. She could have added two pieces of information after each correct answer or alternated two pieces of information, giving one every other response. Individual sessions or having individuals exit the group as they reached criterion may have been more efficient for some students. She may have increased exposure to the extra information had she prompted it as part of the error correction procedure.

Conclusion

Teachers may increase the amount of their students' learning by adding extra material to learning trials through instructive feedback. It requires the following steps:

1. Select the stimuli to be presented through instructive feedback.

2. Decide how to present it: visually, verbally, or in combination.

3. Implement instruction and present instructive feedback on each trial.

4. Monitor student behavior.

The extra information does not impede the acquisition of the target material. It does not add significant time to the training. It does increase the amount of information that students learn. The addition is quick, requires a little more planning, but it makes teaching more efficient.

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Table 1

Examples of Types of Behaviors Taught Through Instructive Feedback

Types	Target Behaviors	Instructive Feedback Behaviors	Reference
Parallel	Numerals	Number word	Holcombe, Wolery, Werts, & Hrenkevich (1991)
	Coin values	Pennies Number word	Wolery, Werts, Holcombe, Billings, & Vassilaros (in press)
	Fractions	Equivalent fractions	Werts, Wolery, Holcombe-Ligon, & Neumont-Ament (1992)
	Sets	a. number word b. numerals c. Roman numerals	Holcombe-Ligon, Wolery, Werts, & Hrenkevich (1992)
	Labeling photos	Word recognition	Wolery, Doyle, Ault, Meyer & Stinson (1991)
Expansion	Sight words	Definitions	Stinson, Gast, Wolery, & Collins (1991) Shelton, Gast, Wolery, & Winterling (1990) Gast, Wolery, Morris, Doyle, & Meyer (1990)
	Sight words	Spelling	Gast, Doyle, Wolery, Ault & Baklarz (1991a)
	Social studies facts	Additional facts	Wolery, Cybriwsky, Gast, & Boyle-Gast (1991) Gast, Doyle, Wolery, Ault, & Farmer (1991)
	Naming photos of buildings	a. Naming activities b. Reciting addresses	Gast, Doyle, Wolery, Ault, & Baklarz (1991b)
	Rebus symbols	Classifying	Wolery, Holcombe, Werts, Cipolloni (in press)
	Antonyms	a. Reading target word b. Definitions	Harrell, Wolery, Ault, Demers, & Smith (1991)
Novel	Shapes	Colors	Werts, Wolery, Holcombe-Ligon, Vassilaros, & Billings (in press)
	A. Fractions B. State Capitals	Percentages and states	Werts, Wolery, Holcombe-Ligon, & Frederick (1992)

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